AIST REPORT 2023

Create the Future, Collaborate Together

Sustainability Report

AIST

AIST VISION

Create the Future, Collaborate Together

Designing and co-creating the future with society.
Encouraging mutual respect and endeavors.

Our mission
We promote diverse activities beyond the conventional AIST roles through achieving excellence in research, discovering social issues and implementing solutions, underpinning intellectual infrastructure. and assisting with policy advocacy.

Our culture
We foster a culture that attracts diverse people with high aspirations and encourages mutual respect and endeavors.

Our values
We respect creating diverse values through individual strengths and organizational power.

Charter of Environment and Safety

1 We strive to promote research activities that contribute to the global environmental protection and the security of mankind and pursue our work to realize a safe and reliable society of high quality of life harmonious with the environment.

2 In compliance with the applicable laws and regulations related to environmental protection, we establish the autonomous standards of the institute such as Safety Guidelines, etc. and with this in mind, we shall endeavor to conserve environment and promote health and safety at all times.

3 We promote the dissemination of information related to the environmental protection and make every effort to be in harmony with and coexist with the local community. Naturally, in case of disasters or emergencies, we take prompt and proper measures to deal with the situation. Furthermore, in conformity with the 'principles of disclosure,' we shall endeavor to return the knowledge acquired and accumulated to society.

Editorial Policy

The National Institute of Advanced Industrial Science and Technology (AIST) publishes the AIST Report every year as a booklet that introduces the organization's activities and reports on the status of environmental considerations and organizational social responsibility initiatives.

In the first half of the AIST Report 2023, we summarize the overall picture of AIST's activities aimed at becoming the core of the national innovation ecosystem. It also introduces AIST Solutions Co., which was established in April 2023 to strengthen the structure and activities for social implementation of research results. In addition, interviews with researchers working on the "Integrated Fields Project," which promotes research that leads to the solution of social issues, are included.

In the latter half of the report, AIST's wide-ranging activities are divided into categories in which AIST has contact with society, such as environmental considerations, industry–academia–government collaboration, workers, and local communities, and the items required for an environmental report are also explained. Through these contents, we aim to help various stakeholders understand AIST's activities and build a deeper relationship of trust between AIST and society.

Data on environmental reporting of each research base and detailed data on human capital are available on our website.

AIST official website: www.aist.go.jp/

●Activities covered by the report
　Activities at all AIST research bases
●Period covered by the report
　April 2022 to March 2023
●Rounding of numbers
　Rounded to the nearest display digit
●Areas covered by the report
　Organizational governance, human rights, labor practices, fair operating practices, community involvement, environmental activities, occupational health and safety activities, and open innovation activities at AIST
●Guidelines, etc., used as reference
　・Environmental Reporting Guidelines (2018 Edition), Ministry of the Environment
　・Law Concerning the Promotion of Business Activities with Environmental Consideration by Specified Corporations by Facilitating Access to Environmental Information
　・Guidance for Environmental Reporting (3rd Edition), Ministry of the Environment
　・Japanese Translation of ISO 26000: 2010 Guidance on Social Responsibility, Japanese Standards Association (ed.)
　・GRI Standard Global Reporting Initiative
　・Report of the Study Group on Dialogue Contributing to Long-term Management and Long-term Investment for Sustainable Corporate Value Creation (SX Study Group) (Ito Report 3.0), Ministry of Economy, Trade and Industry
●Scheduled date of next edition
　September 2024

CONTENTS

Message from the President:
Aiming for Further Value Creation through the Social Implementation of Technologies
—Start Up of AIST Solutions Co.—

This summer, a heat wave hit the Japanese archipelago as well as all parts of the northern hemisphere. The United Nations has warned the world that "The era of global warming has ended; the era of global boiling has arrived." In addition to the heat wave, torrential rains and droughts have also been a source of major human and economic impact. It can be said, we are in a situation where we can no longer wait on climate change measures. Not only that, but the social issues that await resolution continue to mount, including the declining birthrate and aging population faced by developed countries, and the spread of infectious diseases across national borders.

Since its establishment as an independent administrative agency in 2001, the National Institute of Advanced Industrial Science and Technology (AIST) has conducted research activities to contribute to the development of Japan's economy and society. The Fifth Medium- to Long-term Plan from FY 2020 sets forth a mission to create innovations that contribute to solving world-leading social problems, as well as strengthening economic growth and industrial competitiveness. The plan focuses on the social implementation of research results necessary to realize this mission.

The AIST 5th Term Management Policy defined our vision for the future as, "the core of the national innovation ecosystem." Japan has yet to develop a mechanism to quickly and continuously derive solutions through open innovation. We will play a central role in creating an excellent innovation ecosystem in Japan by collaborating with industry and academia.

The key to this ecosystem is the efficient creation of innovative technological seeds and their rapid implementation in society. To this end, we established the Marketing and Business Development Headquarters in July of last year, and in April of this year, we further developed it into AIST Solutions Co. AIST Solutions identifies social needs through its marketing activities, then backcasts and proposes potential research themes to AIST. AIST Solutions then develops solutions that combine marketing with technological seeds from inside and outside AIST. Furthermore, through collaboration with companies and support for startup creation, we commercialize these solutions in the form of products and services, thereby creating new value in society.

In order to realize an excellent national innovation ecosystem, it is important not only to have a Coalition of the Strong led by AIST Solutions, but also to think in terms of regional innovation, wherein open innovation mechanisms are implemented throughout Japan, and new industries are created through technological innovation. AIST established its 12th research base, the Hokuriku Digital Manufacturing Center, in May of this year. In July, AIST established a center at Kanazawa Institute of Technology, under the new "Bridge Innovation Laboratory (BIL)" collaboration scheme between AIST, universities, and regional companies. Through these efforts, we aim to create industries based on cutting-edge technologies by strengthening ties between industry, academia, and government sectors in the Hokuriku region.

Recently, an AIST employee was arrested on suspicion of violating the Unfair Competition Prevention Act. We take this matter very seriously, and the entire AIST group is working to prevent a recurrence of such an incident by further strengthening information management among other measures. We will continue to do our utmost to restore confidence in our institute through ongoing follow-ups, including reviews by outside experts to ensure the effectiveness of our measures.

This report mainly introduces AIST's initiatives in FY 2022, and is structured to provide an overview of the flow of value creation through social implementation of technology. By outlining AIST's activities as clearly as possible, we hope that many people will gain a better understanding of AIST, and that the circle of open innovation will be further expanded.

We sincerely appreciate your continued cooperation and support of AIST.

ISHIMURA Kazuhiko

President & CEO
National Institute of Advanced Industrial Science and Technology (AIST)

External Vice-President's Message

New Approaches to Social Implementation of Technology and the Evolution of AIST

The world around us is facing a variety of increasingly serious structural problems such as climate change, food and energy issues, widening inequality, and rising geopolitical risks, and the future is becoming increasingly uncertain. At the same time, we live in an era of overwhelming innovation that could transform our social structure and living environment, including advances in generative AI, quantum technology, energy-related technology development such as SMR and nuclear fusion, and biotechnology. We must realize Society 5.0, the well-being society we advocate, by solving the social structural problems we face through the implementation of these innovative technologies in society. In this sense, the significance and importance of AIST, which plays a leading role in opening up the future with the power of science and technology, is certain to increase in the future.

One of the major challenges for the promotion of science and technology in Japan is how to quickly and organically link research and development with social implementation. In this sense, the establishment of AIST Solutions, under the leadership of President Ishimura, is an extremely important initiative, as it aims to develop social implementation directly linked to social needs through an active approach from AIST to industry. AIST's basic management policy is to be the core of the national innovation ecosystem, and the AIST Solutions initiative must succeed in realizing this organizational goal. We in the industry fully support this effort and hope to make a major milestone by cooperating with each other.

President Ishimura has also been working on various organizational reforms, including the governance structure, since assuming the position of President, and he will continue to boldly take on the challenges of new issues surrounding AIST, such as promotion of data utilization and research integrity, human resource development, collaboration with local economies, start-up initiatives, and further internationalization. In order to overcome these challenges and for AIST to further evolve, the strong engagement of all of AIST staff is indispensable. I strongly hope that each and every one of you, the staff, will think proactively about what AIST should be and act accordingly.

I hope that the evolution of AIST will make a significant contribution not only to the future of Japan, a country with advanced issues, but also to the stability of the world.
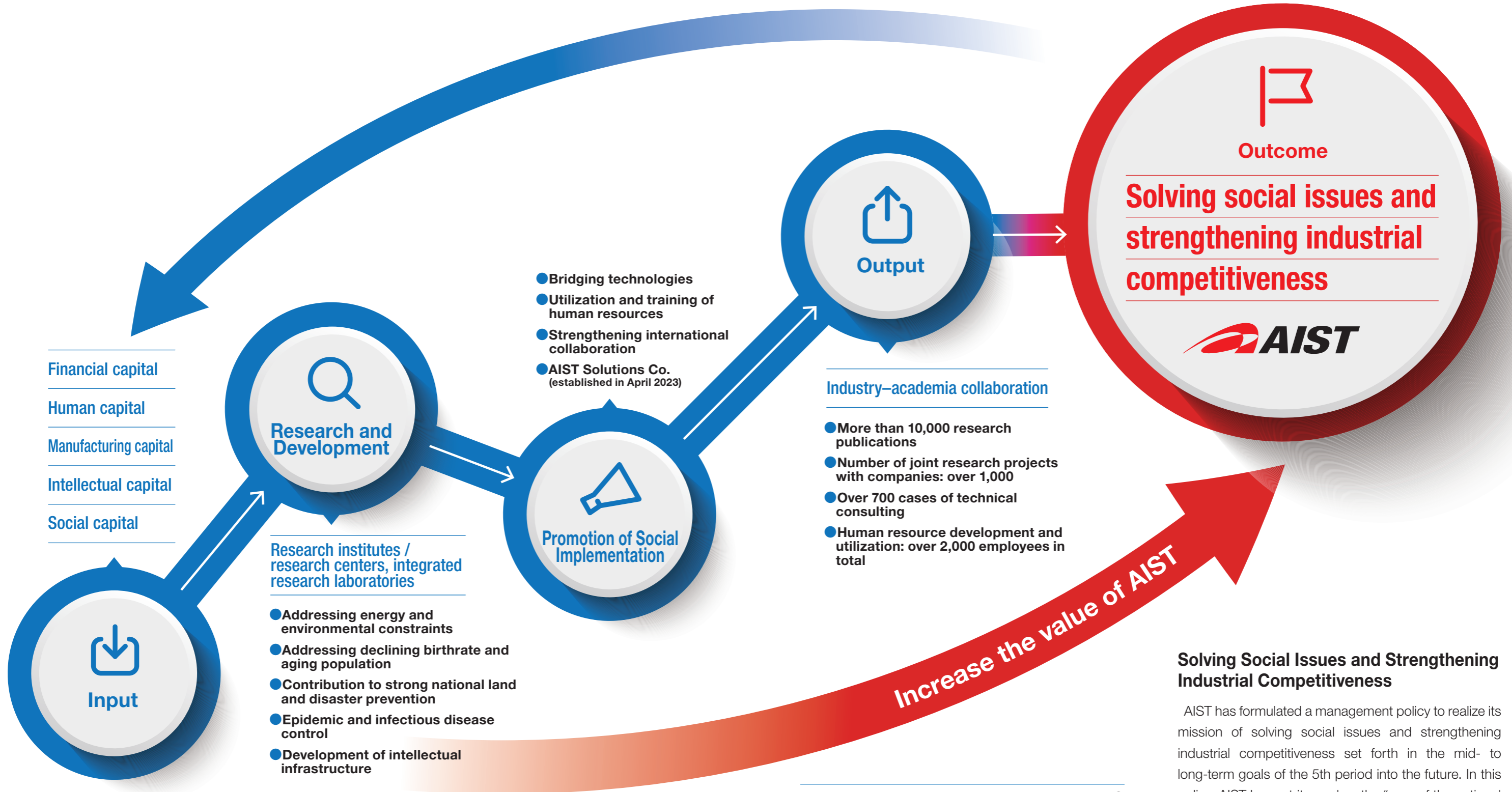
Vice-President (part-time)
Senior Advisor, Mizuho Financial Group, Inc.

SATO Yasuhiro

Efforts to Establish a National Innovation Ecosystem

Outcome

Solving social issues and strengthening industrial competitiveness

AIST

Output

- Bridging technologies
- Utilization and training of human resources
- Strengthening international collaboration
- AIST Solutions Co. (established in April 2023)

Industry–academia collaboration

- More than 10,000 research publications
- Number of joint research projects with companies: over 1,000
- Over 700 cases of technical consulting
- Human resource development and utilization: over 2,000 employees in total

Research and Development

Promotion of Social Implementation

- Financial capital
- Human capital
- Manufacturing capital
- Intellectual capital
- Social capital

Research institutes / research centers, integrated research laboratories

- Addressing energy and environmental constraints
- Addressing declining birthrate and aging population
- Contribution to strong national land and disaster prevention
- Epidemic and infectious disease control
- Development of intellectual infrastructure

Input

Increase the value of AIST

Solving Social Issues and Strengthening Industrial Competitiveness

 AIST has formulated a management policy to realize its mission of solving social issues and strengthening industrial competitiveness set forth in the mid- to long-term goals of the 5th period into the future. In this policy, AIST has set its goal as the "core of the national innovation ecosystem" for the 7th period and beyond (FY 2030 and beyond), and backcasting from this future vision, the 5th period aims to build a prototype of the ecosystem.

 The AIST Group including AIST Solutions (AISol) aims to double its current scale of operations to that of 200 billion yen by FY 2030 and beyond.

Issue	Strengthening team capabilities	
Initiatives	Initiatives to improve engagement	**P40**

Issue	Research that leads to solutions to social issues	
Initiatives	Interdisciplinary research	**P08**

Issue	Acceleration and visualization of social implementation	
Initiatives	Establishment of AIST Solutions Co.	**P06**

Establishment and Purpose of AIST Solutions Co.

TECHNOLOGY ✕ MARKETING Solving social issues and contributing to the creation of new business value

Aiming to solve social issues and strengthen industrial competitiveness

AIST has been strengthening its systems and activities for social implementation of research results in order to achieve its mission of solving social issues and strengthening industrial competitiveness. AIST Solutions Co. (hereafter referred to as "AISol"), a wholly owned subsidiary of AIST, was established in April 2023, in accordance with the Law Concerning the Revitalization of Science, Technology, and Innovation Creation.

As a country with few natural resources, Japan's energy self-sufficiency rate and renewable energy as a percentage of electricity generated are both lower than those of other major countries. [*1] In the U.S., nominal GDP has increased in proportion to the growth of digital investment (hardware and software combined), while both have been stagnant in Japan for nearly 30 years.[*2]

There is a limit to what companies can do with their own internal resources to solve social issues and strengthen industrial competitiveness. It is important to promote open innovation that actively utilizes the research results of other companies, research institutions, and universities, but Japan lags behind other major countries in this respect.[*3]

AIST established AISol in order to break out of this current situation in Japan.

*1 Based on IEA "World Energy Balances 2021" estimates for 2020, IEA "Market Report Series—Renewables 2021 (electricity generation in each country as of 2020)," IEA database, Comprehensive Energy Statistics (2020 confirmed report data), etc.
*2 Based on data from the First Meeting of the Industrial Structure Council's New Opportunities Subcommittee on Economic and Industrial Policy.
*3 Based on "Science and Technology Indicators 2022," National Institute of Science and Technology Policy, Ministry of Education, Culture, Sports, Science and Technology.

AIST and AISol working together to create new business value

AIST conducts basic research, applied research, and empirical research with an eye to future social issues, and links the results to social implementation at the optimum time through joint research with companies. AIST is repeating this cycle to address new social issues and to create business value through AISol.

AISol has started its activities with 150 members, gathering human resources not only from AIST but also from private sector companies. We will appeal for open innovation through top sales to corporate management, promote collaborative activities with companies centered on coordinators and producers, and promote projects with quick decision-making from the perspective of companies.

● **National Innovation Ecosystem**
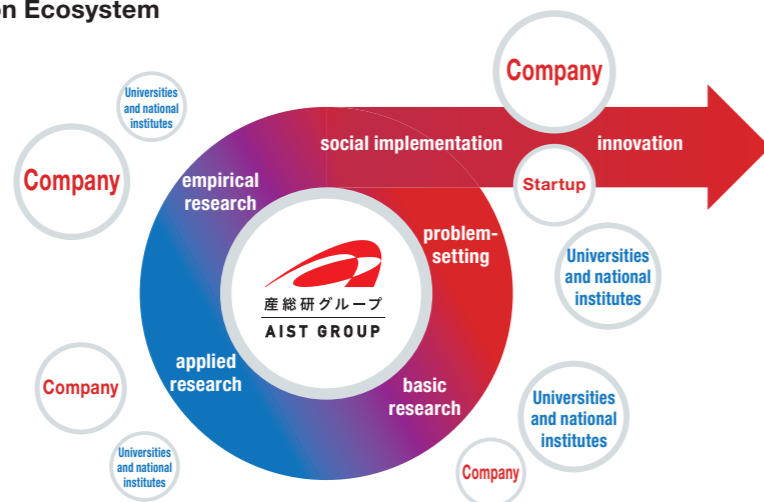
Contribution to a prosperous future society created by science and technology

● **AISol's business**

Technological assets	Collaborative research	Business co-creation

Intellectual assets
● Licensing
● Providing IP information

Facilities assets
● For research
● For engineering

Technical consulting
● Measurement, analysis and diagnosis
● Providing solutions

● Market research and analysis
● Proof of concept and development of minimum viable product
● Social implementation of prototypes

● Solving social issues
● Value chain development
● Startup business creation

AISol incorporates AIST's accumulated technologies to meet commercial needs and strengthen its ability to propose solutions to social issues. We are building six solution areas: "Energy Solution," "AI/Semiconductors," "Circular Economy," "Material DX," "Biotech/Well-being," and "Digital Platform." Focusing on these areas, AISol will provide technology assets, coordinate joint research, implement empirical projects for social implementation, and build value chains. AISol is also actively involved in the creation of startups that create high business value. Specifically, AISol certifies startups that match the management policies of the AIST group in terms of contribution to solving social issues, technological competitive advantage, marketability, and synergy with AIST, as "AISol startups" and promotes business co-creation. Together with AIST, we will support the growth of "AISol startups" from various aspects such as engineering, marketing, business acceleration, and capital reinforcement, and promote their commercialization together.

On Friday, May 26, 2023, a ceremony was held at Tokyo Kaikan (Chiyoda-ku, Tokyo) to commemorate the establishment of AISol and to introduce the new organization, its business, and AIST and AISol's efforts toward social implementation to many companies, universities, national institutes, and government agencies.

● **Six business areas that AISol is involved in**

Company Profile

Company name: AIST Solutions Co.
Location: (Tokyo) 1-1-1 Nishi-Shinbashi, Minato-ku, Tokyo (Tsukuba) 1-1-1 Umezono, Tsukuba, Ibaraki Prefecture
Date of establishment: April 1, 2023
Representative: OSAKA Seiji
Capital: 100 million yen
Investor: National Institute of Advanced Industrial Science and Technology (100%)

Resolving Social Issues through Integration of Fields

AIST has declared spearheading solutions to social problems as one of the missions of the Fifth Medium- to Long-term Plan. Particularly to achieve the SDGs, breakthrough innovations are needed to address social problems, such as energy and environmental constraints, the declining birthrate, and aging population, and to contribute to sustainable economic growth and stronger industrial competitiveness in Japan. We have specified four social problems that need to be addressed: responses to energy and environmental constraints; measures for the declining birthrate and aging population; contributing to a resilient country and disaster prevention; and measures for epidemic control and infectious diseases. The whole Institute will work on strategic research projects to contribute to solutions to these social problems. Synergistic initiatives beyond the scope of existing research departments will be needed for these solutions. As a system for all parts of AIST, we are setting up integrated research centers and integrated research laboratories. AIST Report 2023 features four of the eight integrated research centers and laboratories that were not introduced in the previous year.

Addressing energy and environmental constraints

Centered on the Global Zero Emission Research Center (GZR), we are developing basic technology for sharp reductions in greenhouse gas emissions. Centered on the Resource Circulation Technology Research Laboratory at the center, we are developing advanced resource utilization technology and system evaluation technology for a resource circulating society. Centered on the Research Laboratory on Environmentally-Conscious Developments and Technologies, we are developing environmental evaluation, restoration, and management technology for environmental conservation and for harmony of development and utilization.

Measures to address declining birthrate and aging population

Centered on the Industrial Cyber-Physical Systems Research Center, we are developing technology that contributes to improvements in labor productivity and to skills development and transfer in all industries. Centered on the Advanced Healthcare Service Research Laboratory, we are developing technology that contributes to next-generation healthcare services using advanced technologies that fit into everyday life. Centered on the New-generation Medical Treatment and Diagnosis Research Laboratory, we are developing high-quality, highly functional, high-precision medical care and diagnostics technology that improves quality of life (QoL).
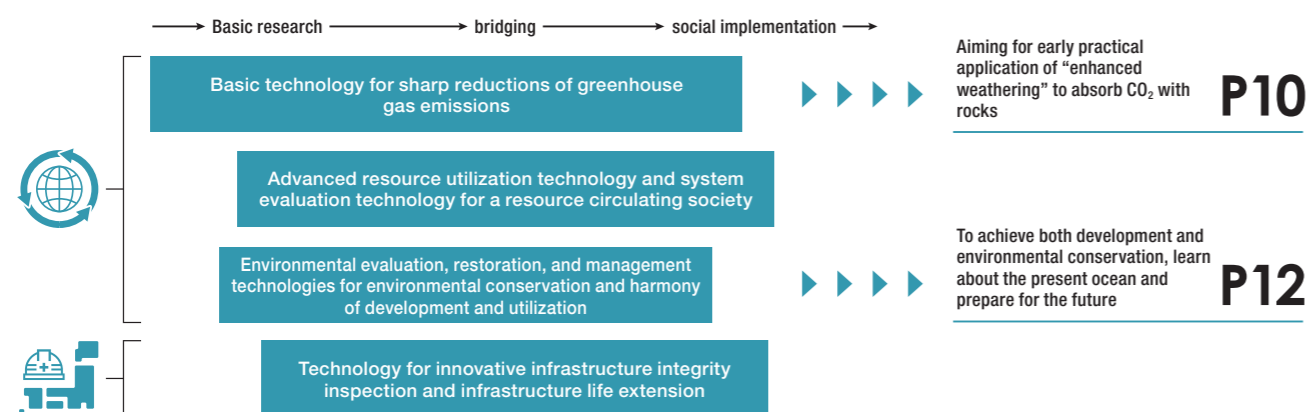
Contributing to a resilient country and disaster prevention

Centered on the Sustainable Infrastructure Research Laboratory, we are developing technology for innovative infrastructure integrity inspection and prolonging infrastructure life to make society sustainable, safe, and secure.
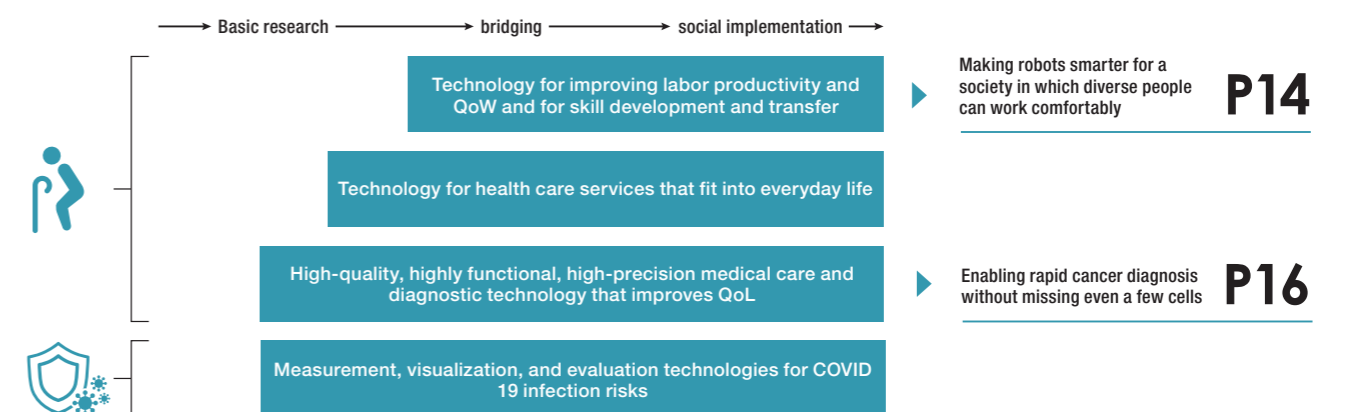
Measures for epidemic control and infectious diseases

Centered on the Research Laboratory for COVID-19 Infection Risk Assessment, we are developing measurement, visualization, and evaluation technology for COVID-19 infection risks.

Research report index

Basic research → bridging → social implementation →

Basic technology for sharp reductions of greenhouse gas emissions	Aiming for early practical application of "enhanced weathering" to absorb CO_2 with rocks **P10**
Advanced resource utilization technology and system evaluation technology for a resource circulating society	
Environmental evaluation, restoration, and management technologies for environmental conservation and harmony of development and utilization	To achieve both development and environmental conservation, learn about the present ocean and prepare for the future **P12**
Technology for innovative infrastructure integrity inspection and infrastructure life extension	

Research report index

Basic research → bridging → social implementation →

Technology for improving labor productivity and QoW and for skill development and transfer	Making robots smarter for a society in which diverse people can work comfortably **P14**
Technology for health care services that fit into everyday life	
High-quality, highly functional, high-precision medical care and diagnostic technology that improves QoL	Enabling rapid cancer diagnosis without missing even a few cells **P16**
Measurement, visualization, and evaluation technologies for COVID-19 infection risks	

Research Institute for Geo-Resources and Environment
CO₂ Geological Storage Research Group

Group leader
SORAI Masao

Global Zero Emission Research Center

Deputy Director
YAMAMOTO Atsushi

Global Zero Emission Research Center
Environmental and Social Impact Assessment Team

Team leader
MORIMOTO Shinichirou

Aiming for early practical application of "enhanced weathering" to absorb CO_2 with rocks

Nowadays, the research and development toward carbon neutrality is accelerating worldwide. One technology that is attracting attention among negative emission technologies that absorb CO_2 from the atmosphere is "enhanced weathering." For a new technology to be accepted by society, it is necessary to determine what kind of rules need to be established and what issues need to be cleared. AIST is developing technologies for enhanced weathering and evaluation platforms to optimize their effectiveness.

Evaluate the effectiveness of enhanced weathering by observing how much CO_2 can be reduced

Technology to capture and store CO_2 emitted from factories and power plants is attracting attention in order to achieve carbon neutrality by 2050. However, the amount of CO_2 that can be separated and recovered from such fixed sources is limited, so CO_2 emissions cannot be reduced to zero or negative by this alone. For this reason, negative emission technologies that capture and store CO_2 originally from the atmosphere are attracting attention as a technology to offset the amount of CO_2 that must inevitably be emitted.

One of them is "enhanced weathering." First, we asked Morimoto Shinichirou what enhanced weathering is in the first place and what kind of

research theme it is.

"Rocks, if left untreated, will combine with CO_2 over a long period of time to form carbonates. This phenomenon is called chemical weathering. In order to artificially accelerate this weathering phenomenon and absorb CO_2, we are cond ucting research on crushing basalt and other rocks into fine powder and scattering it on farmland, as well as on producing carbonate industrially. We are measuring and analyzing the CO_2 reduction effect, developing the most effective method to accelerate weathering, and studying the effect on plant growth when pulverized rock is spread on farmland. Ultimately, we are trying to put together a scenario that consolidates the data obtained from these studies and proposes how best to create a system that can actually be used in society."

A path will open with the fusion of disciplines of a diverse research team

"An enhanced weathering project cannot proceed without the cooperation of various experts in geology, measurement standards, and evaluation. A geological database is indispensable to know what kind of rocks can be obtained in what kind of places, and without knowledge of cost-conscious evaluation and what is needed for this technology to be accepted by society, it will not be implemented in society. AIST was able to put together a system that combined a variety of technologies," says Yamamoto Atsushi, who worked hard to build the research team.

We spoke with Sorai Masao, a geology expert who is also a member of Global Zero Emission Research Center, about the benefits of working with researchers in different fields.

"At first, I was puzzled by how different the time scales were. In the geological world, even basalt that is one million years old is still young and not yet reacting, but in the world of enhanced weathering, they are trying to do it artificially in just one year. From the geological side, it is common sense to say, "There is no way we can do that," but this time, by incorporating a completely different perspective and technology, we came to think, "We can do it." Japan is a volcanic country with a relatively large amount of basalt, so I believe there is ample potential to accelerate weathering."

Crushing basalt into small pieces until it becomes powdery is an effective means of accelerating weathering, and we are currently developing a technique using ultrasonic pulverization. Reducing the energy and cost of such crushing is also an important consideration.

In addition to long-term field exposure experiments, we also collect data on CO_2 absorbed by the soil by measuring it in the laboratory under varying humidity, temperature, pH, and other conditions, and by actually spreading it on the soil.

To transmit world-class guidelines

There are still no globally accepted guidelines for enhanced weathering. AIST's challenge was to create rules that could become a global standard. Morimoto was responsible for thorough data management toward this end.

"I frequently discuss with the members how to conduct experiments and compile data, and how to use that data for calculations with researchers from various fields," he said. "Our goal is to accumulate those data and derive the optimal conditions for social implementation, thereby contributing to global enhanced weathering."

Morimoto sees social acceptability as the biggest issue in social implementation. Therefore, it is important to evaluate the plant growth effect and consider how to spread crushed rocks that can be accepted by local residents. At the same time, it is also necessary to properly evaluate the risks of what may happen after the spreading, and then set rules to minimize the risks.

With dream technology, contributing to global environmental preservation

The enhanced weathering project is a new research project that just started in December 2022, and despite the fact that it is a new research project, Sorai says, "If we can reduce CO_2 emissions by using rocks that are close to us, it is a very dream-inspiring technology."

We asked Morimoto about his outlook on how to contribute to CO_2 reduction, a challenge common to the world. He said, "Enhanced weathering is one of the CO_2 reduction technologies that can be easily initiated because of the simplicity of the equipment required. At the same time, it has the potential to expand agriculture and create jobs because it can promote the growth of crops. It is a negative emission technology that can be easily tackled in any country or region in any environment. I believe it is my mission as a researcher to globalize the technology from such a perspective."

Yamamoto also commented on the importance of global initiatives, saying, "The Global Zero Emission Research Center is a center that aims to bring together the world's wisdom and innovation in order to contribute to the reduction of CO_2. This is an extremely difficult mission, and we must collaborate with people around the world in order to put it to practical use. We intend to make enhanced weathering a technology that can contribute to global warming countermeasures."

AIST will support global environmental preservation through the design of a total system that includes the utilization of fixed CO_2.

Research Laboratory on Environmentally-conscious Developments and Technologies
Marine Environment Research Team

Senior researcher
YAMAOKA Kyoko

Research Laboratory on Environmentally-conscious Developments and Technologies
Marine Environment Research Team

Senior researcher
NAGAO Masayuki

To achieve both development and environmental conservation, learn about the present ocean and prepare for the future

Surrounded by the sea, Japan is a maritime nation with the sixth largest territorial waters and exclusive economic zone in the world. When conducting various types of development in the ocean and coastal areas, environmental impacts cannot be ignored. In order to realize a sustainable society, there is a strong need to harmonize development and the natural environment. AIST is working on the development of technologies for marine environmental impact assessment and the dissemination of the research results to the world.

First, survey environment before development, to mitigate impacts and risks

From the deep ocean floor to the beautiful coral reefs in coastal areas, marine environment is greatly affected by climate change, natural disasters, and industry. For example, valuable mineral resources lie on the seafloor surrounding the Japanese archipelago. Without data to determine how the ecosystem near the seafloor will be affected by future attempts to mine these resources, and how to minimize the impact, it will be impossible to conserve the environment. For this purpose, an environmental impact assessment is necessary. Research Laboratory on Environmentally-conscious Developments and Technologies (E-code) conducts a wide range of research, from environmental impact assessments related to the development of marine mineral resources to the conservation and utilization of biodiversity in coastal areas.

In 2020, Japan became the first country in the world to successfully conduct excavating test of "cobalt-rich ferromanganese crusts," which contains cobalt, an element essential for battery production and other applications, in the exclusive economic zone (EEZ) south off Minami-Torishima Island. In order to conduct such excavating tests, it is essential to assess the environmental impact of the surrounding ocean. AIST has been conducting environmental surveys in accordance with the guidelines of the International Seabed Authority (ISA), which manages the framework for the orderly utilization of marine resources, which are the common property of mankind.

First, it is required to survey the natural state of the ocean and to obtain basic baseline data prior to development, and then to predict and evaluate the impacts of the development. Even if it is within the EEZ, the oceans are connected, so development must take the environment into consideration or the world will not be convinced. AIST aims to be the first

in the world to provide a roadmap for harmonizing development and environment.

With physics, chemistry, and biology perspectives, approach to environmental impact assessment

AIST's strength in environmental impact assessment is its ability to integrate research conducted by specialists in physics, chemistry, and biology. The following is an introduction to the type of research being conducted in each field.

Nagao Masayuki in the physics field is developing a monitoring system to measure water currents and sounds on the deep-sea floor. He says, "We are installing two types of current meters and an underwater sound recorder to an unmanned diving lander that can take images of the deep-sea floor, and working on the research to use it as a multi-platform system. We are taking baseline data on ocean physical properties more conveniently, cost-effectively, and reliably."

AIST is also conducting research to measure the effects of particles and sounds generated by drilling on the deep-sea environment by combining data such as images and underwater sounds acquired by the diving lander with AI technology.

Yamaoka Kyoko, in the chemistry field, is conducting research to obtain baseline data on heavy metal elements dissolved in seawater. She says, "Unlike when measuring metal elements in sediments on the seafloor, measuring metal elements with low concentrations in seawater is a job with high technical hurdles. At first, we could not measure them well because of the high concentration of salt in seawater. However, in collaboration with researchers in NMIJ, we improved analytical techniques using NMIJ reference materials with their technical support, and were able to make highly reliable measurements."

Iguchi Akira, a researcher in the biology field, is conducting research to evaluate marine biological resources in the deep sea and Okinawa by making full use of environmental DNA analysis technology, which is currently the focus of much attention. This technology allows researchers to determine what kind of organisms are living there simply by examining drawn seawater. What is unique in the deep-sea initiative is that it focuses on sponges. Sponges are living organisms that filter seawater in a filter-like manner, and they store genetic information on many surrounding organisms in their bodies. Therefore, even without pumping and filtering seawater, we can learn about the biodiversity of a site by examining sponges.

In addition to the advancement of elemental technologies in each of these fields, there are many examples of E-code-like efforts to analyze environmental information in an integrated manner.

With research using state-of-the-art technology, what coral reefs can teach us

Iguchi conducts a variety of research on corals. "Coral reefs have the highest biodiversity in the

ocean and nurture a large number of species. That is why they are the focus of so much research around the world, and in fact corals are the subject of the most advanced genome analysis technology among marine organisms. Therefore, environmental impact assessment research on corals is a cutting-edge field."

Even on the main island of Okinawa, the health of corals differs greatly between the northern part of the island, where rich nature remains, and the southern part, where development is progressing. To determine the cause of this difference, Iguchi undertook a biological impact assessment based on rearing experiments.

"It is well known that coral declines when excessive nutrients flow in from land, but the mechanism of this decline has been a mystery. Therefore, we kept small newborn corals in petri dishes together with sand collected in the northern and southern regions and compared them. Through joint research with Kitasato University and the University of the Ryukyus, we discovered for the first time that phosphorus released from the sand directly hampers coral growth. These results are useful for evaluating phosphorus in marine areas and are being used in a coral conservation project by the Ministry of the Environment."

In addition, we are also focusing on research to comprehensively evaluate under what conditions corals are less likely to grow and die by using the latest bioinformatics analysis techniques, such as gene expression analysis and techniques that can examine small-molecule chemical substances.

Research Laboratory on Environmentally-conscious Developments and Technologies
Coastal Environment Research Team

Senior researcher
IGUCHI Akira

Iguchi during field research

It can be used for positive evaluation, as technology for ESG investing

Nagao, Yamaoka, and Iguchi's goal is to implement their environmental assessment technologies in society. Moreover, they hope that the technologies will be used not only to assess risks, but also to evaluate positive environmental impacts.

As part of "society's preparedness" to harmonize development and environment, AIST will contribute to the conservation of marine environment by conducting research to make environmental impact assessment technologies useful for ESG investing (investments in companies that take environmental, social, and governance issues into consideration).

Industrial Cyber-Physical Systems Research Center
Automation Research Team

Senior researcher
HANAI Ryo

Industrial Cyber-Physical Systems Research Center
Automation Research Team

Senior researcher
RAMIREZ ALPIZAR Ixchel

Making robots smarter for a society in which diverse people can work comfortably

In Japan, approximately one in five people of the population is expected to be 75 years old or older by 2025. In order to solve the labor shortage caused by the declining birthrate and aging population, automation technologies are now being developed in all industries. AIST is developing technologies to enhance the autonomy and cooperation of robots by making full use of simulation and AI. Our goal is to create a society where a diverse range of people can work comfortably, and productivity can be continuously improved.

Introducing smart robots in preparation for labor shortages

Japan has one of the world's fastest aging populations due to its declining birthrate. The population of the workforce generation is expected to continue to decline, and labor shortages are becoming a serious social problem. To compensate for this, automation through the introduction of robots and other means is expected. The Automation Research Team is conducting research to increase labor productivity by enhancing the autonomy of robots and to facilitate cooperation between humans and robots. We first asked Hanai Ryo about the direction of their research.

"There is still a limit to what robots can do, and it is very difficult to create a robot that can do any task. Nevertheless, there are many tasks in the world that we would like to automate, such as work in manufacturing plants and distribution warehouses,

displaying and setting out items in stores, cooking, etc. It is important to find a way to introduce robots in a cost-effective manner. We are working to make robots smarter by considering what technology is necessary to achieve this. Our goal is to make robots autonomous and capable of dealing with various situations, even if there are few parts that need to be prepared and built in advance by people."

Utilizing simulation moving from experience acquisition to experience expansion

Robots are good at tasks that are assumed in advance, but this limits the number of situations in which they can be used in the field. For example, if a robot can reason from its experience how to handle metal, rubber, or sponge when it sees it for the first time, it will be more versatile. However, it takes time

and money to learn a large amount of information about what to handle and how to handle it. We asked Ramirez Alpizar Ixchel how she is trying to overcome this challenge.

"When we want the robot to learn how to pick things up, it is very inefficient to learn by actually preparing various objects and acquiring experimental data. So we used a simulator that can reproduce physical phenomena to obtain a huge amount of data in a short period of time. Furthermore, we are advancing our research from experience acquisition to experience expansion so that more complex decisions can be made, such as how to pick one item at a time when multiple items are entangled."

One of the areas that has been attracting attention in experience expansion is "force estimation," which Hanai is working on. "For example, when a heavy brick is placed on top of a light box of snacks, humans can roughly imagine the force between the brick and the snack box without touching them, and can figure out how to successfully remove the snack box. We are conducting research to give robots the ability to estimate the forces exerted on objects in this way. The key to our technology is the use of simulation. We use simulations to predict what forces are applied to overlapping objects, information that cannot be obtained in the real world. Using AI that has learned this information, we can predict the distribution of force even from objects that are seen for the first time in the real world, helping the robot to find a natural way to lift objects."

By estimating force, we are trying to develop advanced technology to handle everyday food and household items of various weights and hardness in a versatile manner, for example, to take out a desired item from a shopping cart.

Remote control system with which people and robots help each other

In order for humans and robots to work together, we are also working on building a remote control system. Let the robot do the work it is good at, and humans will help the robot remotely when the need arises in the middle of the work. Ixchel describes this scenario as follows.

"For example, if the robot fails to pick up a tangled part, an alert will appear on a VR head-mounted display worn by a person at a remote location. In the VR environment, that person can give the robot the instruction, 'Push the part in this direction and then lift it up,' and the robot will replicate that motion to pick up the part. There are two advantages to this remote operation: First, since no one enters the work site, there is no need to shut down the equipment for safety reasons. The other is that it opens up workplaces for people with physical disabilities or in wheelchairs, for example."

We have already conducted a demonstration test with Toyota Motor Corporation in a mock-up factory in the research building to pick up automobile parts, and have succeeded in improving productivity while reducing the workload of the workers.

Expanding human collaboration while achieving exciting technology

AIST has a wide variety of experts in robotics, machine learning, computer vision, and other fields, creating an environment conducive to collaboration. There is also a lot of interaction with companies, and it is possible to find research topics by directly talking with them about what kind of work is actually being done at production sites and under what kind of conditions. In this blessed research environment, we asked Hanai about his thoughts on what kind of society he wants to create as a scientist.

"Our goal is to create a society where advanced technology is readily available to everyone. We want to realize robots that make very complex decisions behind the scenes, but are superficially very easy to use and easy to get used to. Recently, there has been some discussion about the dangers of AI. Although technology has such aspects depending on how it is used, I want it to be inherently exciting and fun."

We will continue to strive for further evolution of technology in order to create a society that is easy to work in for a diverse range of people and contribute to solving labor shortages.
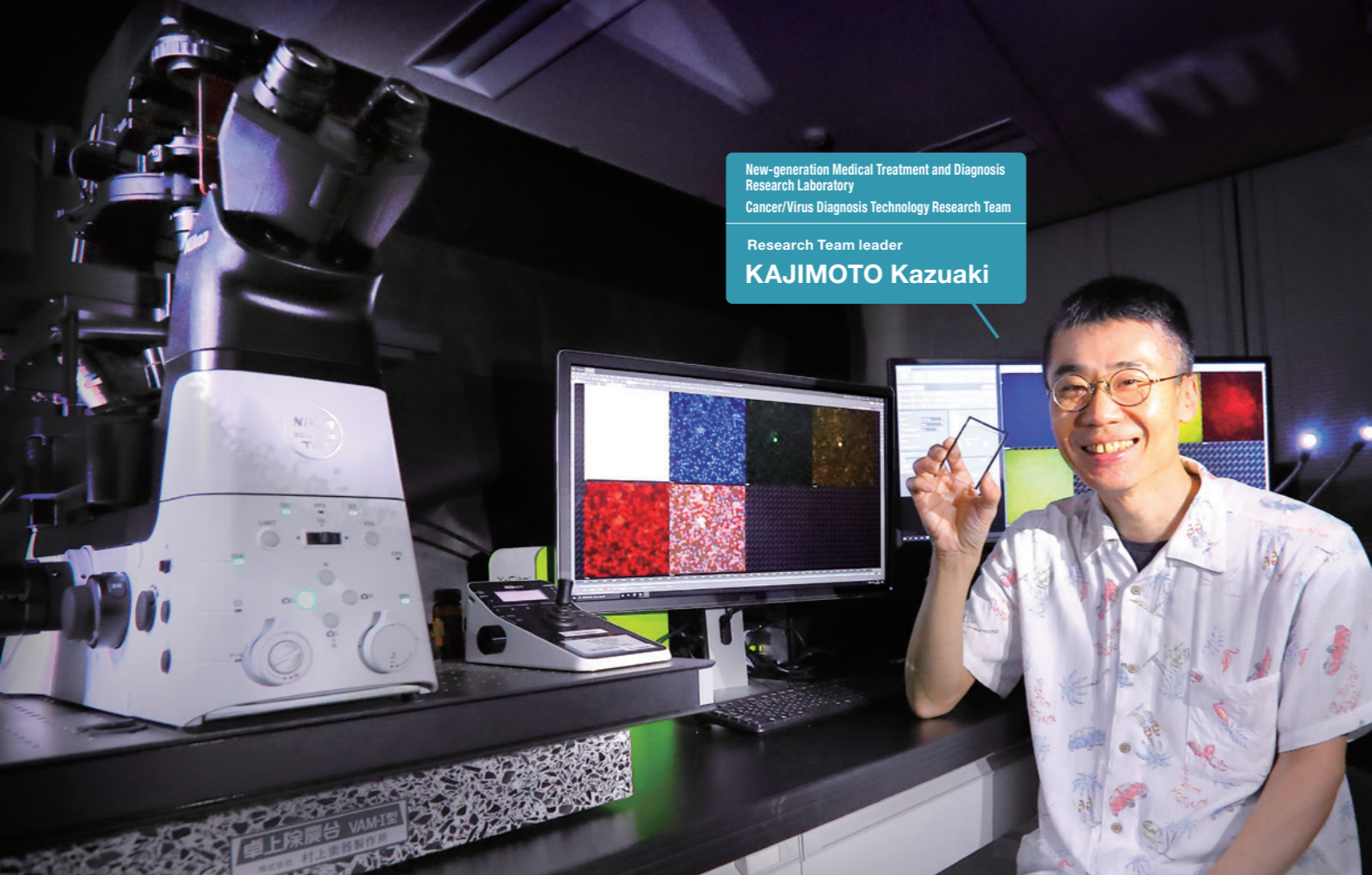
New-generation Medical Treatment and Diagnosis Research Laboratory
Cancer/Virus Diagnosis Technology Research Team

Research Team leader
KAJIMOTO Kazuaki

Enabling rapid cancer diagnosis without missing even a few cells

As we move toward the "100-year life period," it is hoped that we can realize a healthy society with a long life expectancy. As part of this effort, various measures are being taken to prevent and treat cancer, but it remains a disease that threatens our lives and health. AIST has developed a new biochip-based cancer diagnosis technology. The technology, which can accurately examine cancer metastasis and the effects of anticancer drugs just by blood tests, is moving toward practical application.

Detect cells involved in cancer metastasis and also used to determine the efficacy of anticancer drugs

Cancer has been the leading cause of death among Japanese people for more than 40 years, and the number of cancer patients and deaths is increasing as the population ages. Seeing that one in two Japanese will develop cancer in their lifetime and one in four will die from cancer, it is a matter of concern to everyone.

One reason why cancer control is important is that most deaths are due to metastasis, and another is the strong side effects of anticancer drugs. Until now, it has usually taken one to two months to determine whether anticancer drugs are having a successful effect. During that time, patients endure painful side effects and are administered anticancer drugs that have not been confirmed to be effective for their symptoms. Therefore, a technology that can quickly determine the effectiveness of anticancer drugs and

cancer metastasis has been long awaited.

AIST has focused on circulating tumor cells (CTCs), which are cancer cells that circulate in the bloodstream. Once released from the primary cancer site and entering blood vessels, CTCs migrate in the bloodstream and create metastases in distant organs. Thus, CTCs are deeply involved in cancer metastasis, and tracking CTCs in the blood is expected to be utilized as a biomarker, for example, like "a high number of CTCs indicates a shortened survival period," and "a decreased number indicates that anticancer agents are effective."

Arranging cells on a flat biochip, a highly sensitive detection process

The difficulty in measuring CTCs lies in the extremely small number of them. There are tens to 100 million white blood cells in 10 ml of blood, but only a few to a

few dozen CTCs.

Currently, the US-approved method of cancer diagnosis by CTC measurement is useful, but its weakness is that CTCs can be easily missed due to the process of cell enrichment. In addition, this method is not sensitive enough for some types of cancer, such as pancreatic cancer, which can hardly be detected by this method.

To overcome these problems, Kajimoto Kazuaki developed a technology to detect CTCs with high sensitivity by arranging cells in a single layer on a flat plate-like chip made of plastic that is about the size of the palm of your hand.

"When a blood-derived cell suspension is dropped onto a surface-treated flat biochip and allowed to stand, the cells spread throughout and line up in a monolayer. Immunomultiplex staining is performed on the chip to detect cancer cells, which are then observed under a fluorescence microscope. Approximately 10 million cells adsorb on a single biochip the size of a glass slide, and if even one of these cells has a CTC, we can find it."

When we examined the blood of a pancreatic cancer patient in collaboration with a medical institution, we detected 25 CTCs in 7.5 ml of blood. It was also confirmed that CTCs could be detected efficiently regardless of the cancer type. Furthermore, we confirmed that the number of CTCs decreased to 9 one week after the start of anticancer drug administration. This technology is expected to be used to determine the effect of anticancer agents at an early stage.
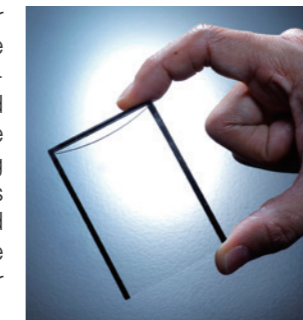
Biochip

Three technologies that bring us closer to practical application: surface preparation, AI, automation

To put the developed biochip to practical use, Kajimoto tackled three issues: first, the surface treatment of the chip, which is key to the CTC detection process, which involves washing the biochip loaded with cells to remove excess cells so that the cells can be retained in a single layer. However, the original oxygen plasma treatment was only effective for one to two weeks. This would make it impossible to distribute the product as an actual usable tool. Therefore, we took on the challenge of developing a surface treatment method that would have a long-lasting effect.

"Although chemical synthesis was completely out of my field of expertise, I developed a unique polymer material over a period of two years by synthesizing more than 300 different materials through a process of trial and error. By coating the cells with it, we were able to make cells adsorb in an extremely short time compared to oxygen plasma treatment and to keep them in a stable monolayer for a long period of time."

The second challenge is how to accurately detect

CTCs, which are extremely few in number. To this end, we are developing a method to automatically identify them using image recognition based on deep learning.

"We are building an AI model to identify cancer cells with the help of researchers within the institute who are good at image recognition. At present, we have succeeded in automatically sorting cancer cells on a chip with almost 100% accuracy in a cultured cell model. If it were not for the Integrated Fields Project, the development of this system might have been delayed even further."

The third challenge is to automate the detection process. We aim to thoroughly automate the process in order to quickly produce correct results. The image we have in mind is a system in which, after blood is collected and the chip and sample are placed in the testing device, all that is required is to press a button and the system will automatically perform cleaning, staining, and detection. The aim is to make the testing process as hands-free as possible, so that anyone can operate the system and obtain correct results without error.

Utilizing biochips aiming to realize tailor-made medicine

Kajimoto is also conducting parallel research using "nano-tweezers," which can grab just one cell. "I am trying to collect only one CTC I find with nano-tweezers in order to analyze cancer cells at the genetic level in more detail, rather than just detecting and counting CTCs. In addition to finding out which organ the cancer cells originate from and what characteristics they have, we may be able to predict which drugs will be effective before starting treatment. In the future, we hope to integrate biochip and nano-tweezer technologies to contribute to the realization of truly tailor-made medicine."

Through his research, Kajimoto has many opportunities to come into contact with cancer patients who are fighting the disease or have returned to society after undergoing cancer treatment, and he has a strong sense of mission: "I want to put this technology to practical use at any cost as a truly useful technology for many people." The ultimate goal he envisions is to incorporate CTC detection into cancer screening so that people can be tested easily. We will make steady progress toward the realization of a society in which anyone can receive necessary medical care anywhere.

🌿 Environmental Safety and AIST

AIST delivers the results of its research and development to society with the aim of solving social issues and realizing a sustainable society. In the process of research and development, AIST conducts its business activities in compliance with laws and regulations, while giving due consideration to environmental safety.

Environmental Policy

AIST has established the Charter of Environment and Safety in order to make steady progress in environmental considerations and other initiatives. Under the Charter of Environment and Safety, we have also established the Environment and Safety Policy, sharing within AIST that "global and local environmental conservation" and "ensuring the safety and health of all AIST employees" are important issues.
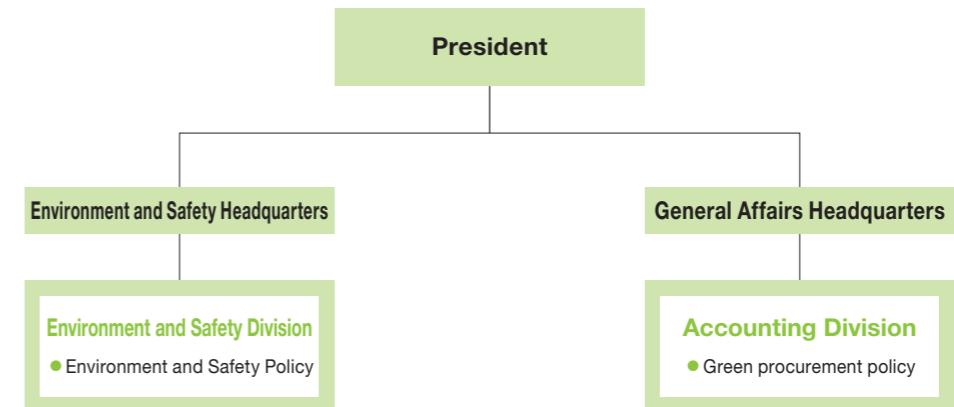
Environment and Safety Policy

1. We proactively conduct research that contributes to conservation of the environment and the development of a healthy and safe society.

2. We comply with laws, regulations, ordinances, and agreements, and strive to protect the environment and to improve health and safety.

3. We seek to reduce the consumption of energy and resources and the generation of waste, and thus aim to reduce loads on the environment.

4. We seek to prevent pollution and work-related accidents, to take prompt and appropriate actions in the event of an emergency, and to prevent the spread of damage.

5. We are conducting activities to ensure environmental conservation, safety and health with the participation of all members of AIST; we seek continuous improvement.

6. We actively disclose environmental, safety and health information by publishing environmental reports and disclosing information to promote communication with society.

We also set a policy for promoting the procurement of eco-friendly goods and services in accordance with the Act on Promotion of Procurement of Eco-friendly Goods and Services by the State and Other Entities and Green Purchasing Act.

Implementation Structure of Policies Related to Environment and Safety

Efforts regarding environmental and safety considerations are promoted under the following system.

- **President**
  - **Environment and Safety Headquarters**
    - **Environment and Safety Division**
      - Environment and Safety Policy
  - **General Affairs Headquarters**
    - **Accounting Division**
      - Green procurement policy
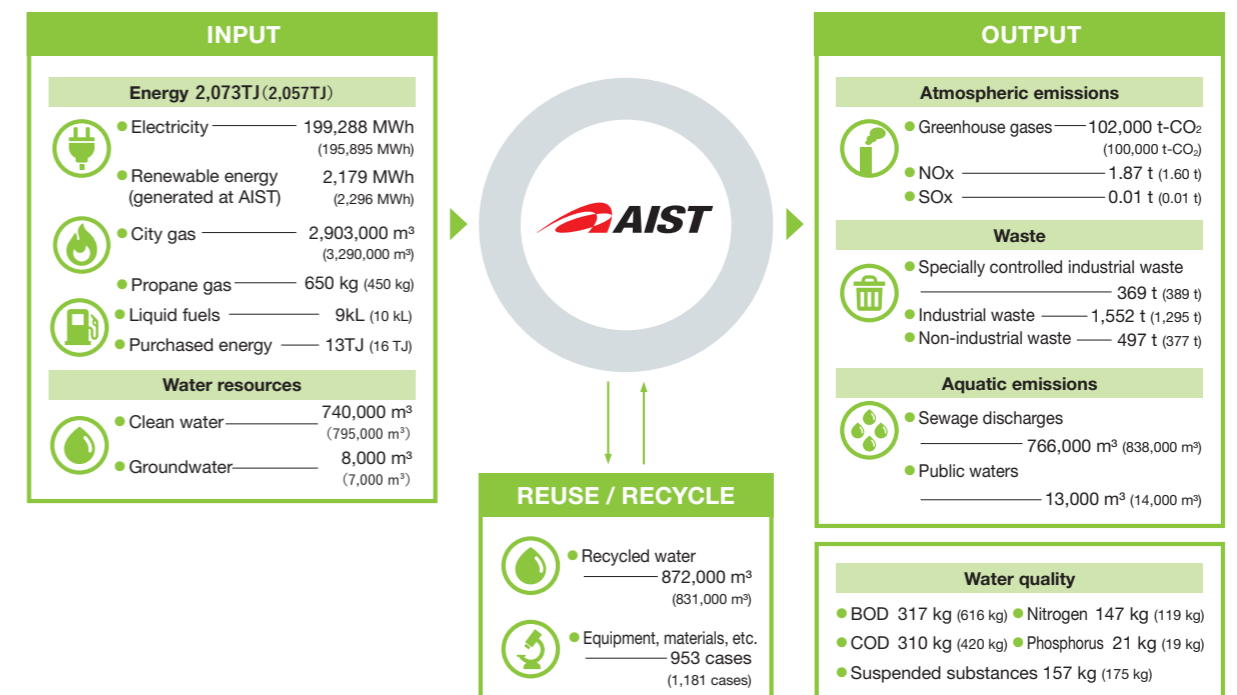
Environmental and Safety Self-check

As a unique initiative, AIST streams "Summary of Incidents and Near Misses (Hiyari-Hatto) and Safety and Health Management" information to all employees via the intranet, and conducts a monthly "Environmental and Safety Self-check" to check the status of their own safety and health efforts after viewing the information.

We implement the PDCA (Plan, Do, Check, Act) cycle, which includes viewing summary of incidents and near misses and safety and health management, implementing safety and health efforts, conducting environmental and safety self-checks, and improving safety education based on inspection results, to ensure the succession of safety and health know-how, reduce potential risks, and prevent accidents.

Overview of Environmental Burdens

( ): FY 2022 results

INPUT

Energy 2,073TJ (2,057TJ)

- Electricity — 199,288 MWh (195,895 MWh)
- Renewable energy (generated at AIST) — 2,179 MWh (2,296 MWh)
- City gas — 2,903,000 m³ (3,290,000 m³)
- Propane gas — 650 kg (450 kg)
- Liquid fuels — 9kL (10 kL)
- Purchased energy — 13TJ (16 TJ)

Water resources

- Clean water — 740,000 m³ (795,000 m³)
- Groundwater — 8,000 m³ (7,000 m³)

REUSE / RECYCLE

- Recycled water — 872,000 m³ (831,000 m³)
- Equipment, materials, etc. — 953 cases (1,181 cases)

OUTPUT

Atmospheric emissions

- Greenhouse gases — 102,000 t-CO₂ (100,000 t-CO₂)
- NOx — 1.87 t (1.60 t)
- SOx — 0.01 t (0.01 t)

Waste

- Specially controlled industrial waste — 369 t (389 t)
- Industrial waste — 1,552 t (1,295 t)
- Non-industrial waste — 497 t (377 t)

Aquatic emissions

- Sewage discharges — 766,000 m³ (838,000 m³)
- Public waters — 13,000 m³ (14,000 m³)

Water quality

- BOD 317 kg (616 kg)
- COD 310 kg (420 kg)
- Suspended substances 157 kg (175 kg)
- Nitrogen 147 kg (119 kg)
- Phosphorus 21 kg (19 kg)

Appropriate Management of Chemical Substances

In order to appropriately manage the wide variety of chemical substances used in our research activities, we have introduced the Chemical and Gas Management System that enables management of the amount of hazardous chemicals and high-pressure gases we possess and use. Through this system, we are also able to ascertain the types and quantities of chemical substances in our possession, and ensure that we comply with laws and regulations and properly manage the quantities in our possession. In particular, the Environment and Safety Division inspects all poisonous substances to confirm their storage conditions.

● **Response to PRTR system**

Based on the PRTR system* and ordinances and guidelines of some local governments, we monitor the amount of relevant chemical substances released into the atmosphere and transferred as sewage and waste. For FY 2022, we report the amounts of chloroform, methylene chloride, n-hexane, hydrogen fluoride and its water-soluble salts, ferric chloride, N,N-dimethylacetamide subjected to the PRTR system, volatile organic compounds (VOCs) subjected to the Osaka Prefecture's ordinance, and ammonia subjected to the Fukushima Prefecture's guidelines.

* PRTR system: Pollutant Release and Transfer Register is a system for reporting the amount of chemical substances released into the environment or transferred out of business establishments as waste, based on the Act on Confirmation, etc. of Release Amounts of Specific Chemical Substances in the Environment and Promotion of Improvements to the Management Thereof, which was introduced in FY 2001. The system requires that the amount of hazardous chemical substances released into the environment and the amount transferred out of business establishments as waste be counted and disclosed to the public. Some local governments have also established similar systems through ordinances.

Consideration for Biodiversity and Animal welfare

In order to comply with the Cartagena Act* to ensure biodiversity, we provide education and training (e-learning) to personnel engaged in recombinant DNA experiments and a total of 997 persons took the course in FY 2022. In addition, we review the content of experiments based on the opinions of the Recombinant DNA Experiment Committee, which is composed of outside experts. Furthermore, in principle, on-site inspections are conducted once a year at laboratories conducting recombinant DNA experiments to ensure that the content of the experiments is consistent with the experimental plan and that the experiments are conducted in accordance with the law.

In animal experiments, we examine whether the 3Rs (Replacement: use of alternative methods, Reduction: reduction of the number of animals used, and Refinement: reduction of suffering) stipulated in the Act on Welfare and Management of Animals are taken into account, and we disclose the results of our self-assessment on our official website. In addition, we have undergone external verification by the Japan Pharmaceutical Information Center (JAPIC) and obtained certification for the animal experiment facilities.

* The Cartagena Act: In Japan, the Act on the Conservation and Sustainable Use of Biological Diversity through Regulations on the Use of Living Modified Organisms came into effect in 2004. It aims to ensure safe handling of living modified organisms that could have adverse effects on the conservation and sustainable use of biodiversity.

Consideration for Water Resources

● **Prevention of water pollution**

Wastewater from laboratories is sent to wastewater treatment plants and processed to abide by the Water Pollution Prevention Act and to meet municipal effluent standards. It is then discharged into the public sewerage system. To prevent water containing hazardous substances from leaking into groundwater, AIST builds dikes and conducts periodic inspections of buried research wastewater pipes and groundwater quality to check for abnormalities.

Wastewater treatment facility in AIST Tsukuba

● **Use of recycled water**

For the efficient use of water resources at AIST Tsukuba and AIST Tokyo Waterfront, research wastewater is neutralized, treated with reducing agents, and reused as recycled water. It is used for cooling laboratory equipment and flushing toilets. In FY 2022, 53% of the total water use was recycled water.

Recycled water tank in AIST Tsukuba

Consideration for Atmospheric Emission

● **Reduction of fluorocarbon emissions**

In accordance with the Act on Rational Use and Proper Management of Fluorocarbons, AIST requires periodic inspections and spot checks of refrigeration and air conditioning equipment that uses fluorocarbons as refrigerants, to restrict emissions of fluorocarbons into the atmosphere. In FY 2022, a total of about 227 t-CO_2 was released, and it was less than the amount (more than 1,000 t-CO_2) required to report under the Act.

● **Prevention of air pollution**

Regarding boilers for air conditioning that are major sources of NOx and SOx, we measure the effluent gases twice a year so that they do not exceed the emission standards under the Air Pollution Control Act. Regarding NOx, in FY 2022, the measurement results were all within the limits. Of SOx, there has been little emission since 2017, and the results fall far below the emission standard. In addition, when replacing equipment, we choose chiller units with high energy-saving effects and downsized units to reduce emissions.

Energy-saving Efforts

We work to reduce energy consumption per unit to an annual average of over 1%* in the medium to long term, an amount required under the Act on Rational Use of Energy. To achieve the target, we actively install devices with high energy-saving effect when renovating facilities, in addition to taking energy conservation measures by appropriate temperature settings of air-conditioners. Our existing solar power systems are being used effectively, and renewable energy systems have been installed in our new buildings. Presently solar power systems are installed at AIST Tsukuba, Fukushima Renewable Energy Institute (FREA), AIST Tohoku, AIST Kashiwa, AIST Tokyo Waterfront, AIST Chubu, AIST Kansai, AIST Chugoku, and AIST Kyushu. Wind power generation is installed at FREA.

Regarding photovoltaic power generation, we aim to install photovoltaic power generation equipment in approximately 50% or more of the area available for installation by FY 2030, in accordance with the "Plan for Measures to be taken by the Government for the Control of Greenhouse Gas Emissions in its Affairs and Businesses."

* Average change of energy consumption per unit over the five-year period of FY 2018–2022: 98.4% (100.7% compared to the previous year)
○Amount of renewable energy generation in FY 2022: 2,179,430 kWh (about 1% of total electricity consumption of AIST)

Compliance with Green Purchasing Act

Each year AIST discloses its policy for promoting the procurement of eco-friendly goods and services based on the Act on Promoting Green Purchasing. In accordance with the Green Contract Law, AIST evaluates the price and environmental performance (fuel efficiency) of automobile leases comprehensively and concludes a contract with the party that achieves the best result in the general evaluation bidding method. In the case of electricity and industrial waste, the contract was awarded to the lowest bidder that cleared the standard after evaluating their reduction efforts for global warming gas emission and compatibility to the certification system for excellence.

Target achievement of specified procurement items stipulated in the Act on Promoting Green Purchasing in FY 2022: 81.8%.

Promotion of 3Rs

AIST is promoting 3R (Reduce, Reuse, Recycle) initiatives to reduce environmental burdens. In particular, since the reuse of research equipment can be expected to reduce costs, AIST has introduced a system to promote the reuse of unneeded research equipment, office equipment, fixtures, and consumables by posting information on its internal website.

○Cases of reuse for FY 2022: 953

Response to Environmental Accidents

AIST conducts contact, communication, and emergency action drills at all research bases once a year to minimize damage in the event of an environmental accident such as a leakage of oil or chemicals. We have a communication system that once the Environment and Safety Headquarters is contacted can immediately deal with an accident if it occurs. After expeditious measures, related organizations are notified. The Environment and Safety Headquarters analyzes the cause of the accident and takes measures to prevent a recurrence of such an incident.

Accident case in FY 2022: leakage of freezer refrigerant (R407C fluorocarbon)
A refrigeration unit that failed to supply chilled water as set was investigated, and a refrigerant leak was confirmed. The leakage was found to be in the evaporator or compressor. As a response, the refrigerant was collected.

Environmental accident drills of FY 2022: 19 accident drills across all research bases
(Assuming damage to research drainage pipes, leakage during transport of waste fluid, etc.)

Scene of an environmental accident drill in which a tank containing waste fluid was being transported on a cart and the tank tipped over, causing the waste fluid to leak (water was used in the drill).

Environmental Education

E-learning is used to educate staff on themes that have impact on the environment, such as how to dispose of waste fluid and emission gas from research, and how to sort and dispose waste.

TOPICS Renovation of Substation Facilities at AIST Tsukuba

AIST has been making various efforts to maintain a sound research environment, and in FY 2022, AIST renovated 21 substation facilities at AIST Tsukuba, which had deteriorated due to aging.

The electricity we use in our daily lives comes from power plants at very high voltages. It is then gradually reduced to a lower voltage at each substation and delivered to each household. For the average home, electricity is transformed by transformers on utility poles to a lower voltage and transmitted to the home. On the other hand, AIST, which uses electricity for research activities, receives electricity at a high voltage, converts it to a low voltage using substations in the facility, and distributes it throughout the facility.

By drawing in high-voltage power, electricity can be purchased at a lower cost than low-voltage power for households, and in the event of problems during power distribution, such as lightning strikes or water leakage, it can prevent accidents by shutting off the current itself. Thus, substation facilities are essential to protect and support the stable research activities of AIST.

AIST has been sequentially upgrading the substation facilities at AIST Tsukuba since before FY 2022 under its mid- to long-term plan. All of the substation facilities that have been renovated so far are high-performance facilities called "Top Runner Transformers" that meet the energy consumption efficiency standard values stipulated by the Energy Conservation Act. By proactively introducing substation facilities with excellent energy consumption efficiency, we are contributing to global environmental protection and the prevention of global warming.

In this way, we are maintaining a healthy research environment by systematically updating aging substation facilities while giving due consideration to the global environment.

Before substation facility renovation

After substation facility renovation

Industry–Academia–Government Collaboration and AIST

Data of Research Activities (FY 2022)

Research presentations (in journals)	**4,033** cases
Research presentations (oral)	**6,756** cases
Joint research projects with companies	**1,019** cases
Joint research revenue	**186.6** million yen
Commissioned research projects from companies	**84** cases
Commissioned research fund from companies	**10.2** million yen
Acceptance of external researchers for joint research	**2,235** people

Innovation coordinator	**56** people
Technology consulting	**784** cases
Technical advice	**2,231** cases
Contribution of AIST researchers to international standardization activities	**534** people
Number of AIST standard proposals	**55** cases
MOUs concluded with overseas organizations	**17** institutes
Foreign researchers	**654** people

Data on Personnel Training and Use (FY 2022)

Cross-appointment program users	**48** people
AIST Research Assistant Program users	**411** people
Technical trainees accepted	**1,351** cases

Students who finished courses at AIST Innovation School	**52** people
Students who finished courses at AIST Design School	**16** people

Technology Bridging

AIST conducts joint research, commissioned research, technology consulting, technical advising, contract testing, provision of research samples and so forth, and contributes to R&D and product development by businesses. At hubs such as the Cooperative Research Laboratories and Open Innovation Laboratories, AIST collaborates with companies and universities to investigate possible applications of technology and promotes open innovation.

Provide a Platform for Industry–Academia–Government Collaboration and Promote Acceptance of Researchers

● **Active invitation of external researchers**
• Number of external researchers for joint research accepted in FY 2022: 2,235
 AIST provides researchers from our joint research partner institutions with an access to AIST's state-of-the-art facilities to conduct effective joint research.

● **A platform for industry–academia–government collaboration**
 AIST recruits members from, and collaborates with, various companies and organizations to organize thematic meeting structures (AIST Consortiums). We explore potential application of cutting-edge technologies and aim at promoting R&D and creating new markets.

● **Joint and commissioned research projects conducted in past years**
 Our joint research is R&D projects between AIST and our cooperative partners—companies, universities, or public research institutions with common objectives and goals—with the aim of creating innovative results that cannot be achieved by individual research. Commissioned research is a type of R&D project conducted solely by AIST under contract with a company or other organization. Through this research, companies can use AIST's research potential to offset their lack of necessary technology to proceed with their own R&D project. Technology consulting is a system by which AIST—a multidisciplinary group of professionals—provides solutions based on its cutting-edge research capability and abundant knowledge to overcome challenges that companies cannot solve by themselves. In FY 2022, 784 cases were conducted.

Marketing Activities toward Creation of Innovation

 At AIST, Innovation Coordinators (ICs) serve as interfaces with external organizations such as companies and universities, and are responsible for coordination of collaboration. In July 2022, AIST established the Marketing and Business Development Headquarters, which has a commercialization concept function to link social implementation themes to be implemented by AIST to commercialization plans and strategies through marketing functions, and is actively building organizational collaboration with companies. In order to promptly and accurately identify the diverse needs of each industry, 56 ICs are engaged in cross-sectional marketing activities across research domains and regional research bases, and are working to bridge the gap between research results and society. In addition, in July 2022, we established the Preparatory Office for the Establishment of a Corporation to Support the Utilization of Research Results and proceeded with preparations for the establishment of AIST Solutions Co. (For details, please see pages 6–7.)
 AIST supports setting up new business and creating new products and services in companies starting from coordinated menus made with various companies using its technology consulting system. Through technology consulting based on analysis of company needs, we propose research themes that span across a number of research domains based on company-wide business plans of partners. We also conduct "co-creation consulting" with companies to consider search of new business seeds and setting of coordinated themes from the concept stage.
 These comprehensive, cross-sector marketing activities are contributing to the creation of innovation through new business and connections between different fields.

Cooperative Research Laboratories

In order to conduct R&D that more closely relates to the strategies of companies, we are collaborating with partner companies and have set up Cooperative Research Laboratories in AIST bearing the names of these partner companies. The partner companies provide researchers and research funding, and AIST provides research resources including researchers, research facilities and intellectual property. The researchers loaned from the companies and AIST's researchers work on R&D in cooperation. As of March 2023, we were operating 19 Cooperative Research Laboratories. We hope they continue to make an impression as platforms for collaboration and synergy involving companies, universities and other research institutes.

In FY 2022, we established the "SOMPO–AIST RDP Collaborative Research Laboratory," the "NLM–AIST Carbon-Neutral Advanced Inorganic Materials Collaborative Research Laboratory," the "Mitsubishi Electric–AIST Human-Centric System Design Collaborative Research Laboratory," and the "Hitachi–AIST Circular Economy Collaborative Research Laboratory".

OIL (Open Innovation Laboratory)

AIST has set up Open Innovation Laboratories ("OILs"), which are industry–academia–government collaborative research bases sited on university campuses. As of April 2023, 7 OILs were in operation. The co-operation of research bases with universities makes it possible to seamlessly conduct basic research, application research, development, and testing. As part of this collaboration, we also utilize our Cross-appointment Program to accelerate research through mobility of human resources as well as the Research Assistant Program to train doctoral candidates by practical approaches. This initiative synergizes the basic research of universities with AIST's goal-oriented basic research and practical technology development, encouraging the "bridging" of our technologies with the industry, which thus leads to solution to social issues. In FY 2022, AIST and universities worked together to further strengthen the bridging function through OIL and improved its hub roles of co-creation among universities, local governments, and companies. Using OILs as hubs, we will continue to promote interdisciplinary integration and put our efforts into strengthening the platforms for collaboration and synergy.

Participation in Technology Research Associations

A technology research association (hereafter referred to as "association") is a mutual assistance organization in which companies, universities, and national research institutes cooperate to conduct experimental research on technologies used in industrial activities by providing researchers, research funds, and equipment, and jointly manage the results and utilize them among the association members. AIST participates as a member and contributes to the activities of the association from planning to research implementation and utilization of the results.

Particularly by sharing our "personnel" and "premises" with the associations, we aim to serve as a field where various people from different organizations can share their knowledge toward co-creation. We thus aim to help promote open innovation.

Specifically, AIST "people" participate in the association as researchers, project leaders, and officers. AIST also provides its facilities and equipment as a "place" for conducting research to researchers from industry and universities who participate in the association.

●**Technology Research Associations in which AIST participated (FY 2022)**

	Name		
1	Photovoltaic Power Generation Technology Research Association (PVTEC)	9	Manufacturing Technology Association of Biologics (MAB)
2	Consortium for Lithium Ion Battery Technology and Evaluation Center (LIBTEC)	10	Thermal Management Materials and Technology Research Association (TherMAT)
3	Fuel Cell Cutting-Edge Research Center Technology Research Association (FC-Cubic)	11	Innovative Structural Materials Association (ISMA)
4	Photonics Electronics Technology Research Association (PETRA)	12	The Research Association of Automobile Internal Combustion Engines (AICE)
5	Technology Research Association for Next Generation Natural Products Chemistry	13	Technology Research Association for Future Additive Manufacturing (TRAFAM)
6	NMEMS Technology Research Organization (NMEMS)	14	Geological Carbon Dioxide Storage Technology Research Association (CCS)
7	Control System Security Center (CSSC)	15	Technology Research Association of Secure IoT Edge Application Based on RISC-V Open Architecture (TRASIO)
8	International Research Institute for Nuclear Decommissioning (IRID)	16	Leading-edge Semiconductor Technology Center (LSTC)

TIA Collaborative Program Exploration and Promotion Project "Kakehashi"

"Kakehashi" is a funding program to support investigative research projects conducted by TIA member organizations (AIST, NIMS, University of Tsukuba, High Energy Accelerator Research Organization, The University of Tokyo, and Tohoku University). 52 research projects (of which 11 represented by AIST) in six fields, including healthcare, biotechnology and electronic devices, were selected as "Kakehashi" themes in FY 2022. In addition, a debriefing session was held to report on the results of FY 2021, and two AIST researchers gave lectures on the results.

Promotion of International Standardization

Standardization themes that crossover a number of industries are increasing such as for various connected products with the advancement of digital technology. Under such circumstances, AIST, with the Marketing and Business Development Headquarters and research domains coming together, is further promoting cross sectoral standardization activities that span over industry and research based on political and industrial needs.

At international organizations such as International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC), 70 AIST researchers are actively serving as chairs, committee managers, or convenors while 464 in total are contributing as experts to the development of standards based on their expertise.

In FY 2022, we proposed a total of 55 domestic and international standards, including an ISO standard for qNMR (quantitative NMR), which enhances the reliability of quantitative analysis of organic compounds including pharmaceuticals, reagents, and food ingredients, and an IEC standard for defect identification and evaluation procedures for high-quality SiC wafers for next-generation power semiconductors.

AIST has increased the number of standardization officers to support the promotion of international standardization for AIST's priority issues since FY 2022. For example, in the area of artificial intelligence (AI), we are promoting the formulation of machine learning quality management guidelines and international standardization activities in ISO/IEC/JTC1/SC42. We are also focusing on the standardization of smart cities and mobile mobility. We also support the development of standardization strategies for the realization of a circular economy based society, which is one of the challenges facing society.

Technology Transfer Activities

It is AIST's mission to contribute to the development of the economy and industry by disseminating its research achievements in society. To achieve this mission, AIST develops a strategic approach to obtain intellectual property (IP) rights, and appropriately maintain and manage such IP rights, and together with the newly established AIST Solutions Co., strongly promotes technology transfer with intellectual property at the core.

Specifically, based on the needs of the partner in cooperation for AIST's intellectual property, we perform the necessary procedures (signing of a non-disclosure agreement, a material transfer agreement, a technical information disclosure agreement, a license agreement and such), and promote wide dissemination of AIST's research outcomes in society.

●**Technology transfer process**
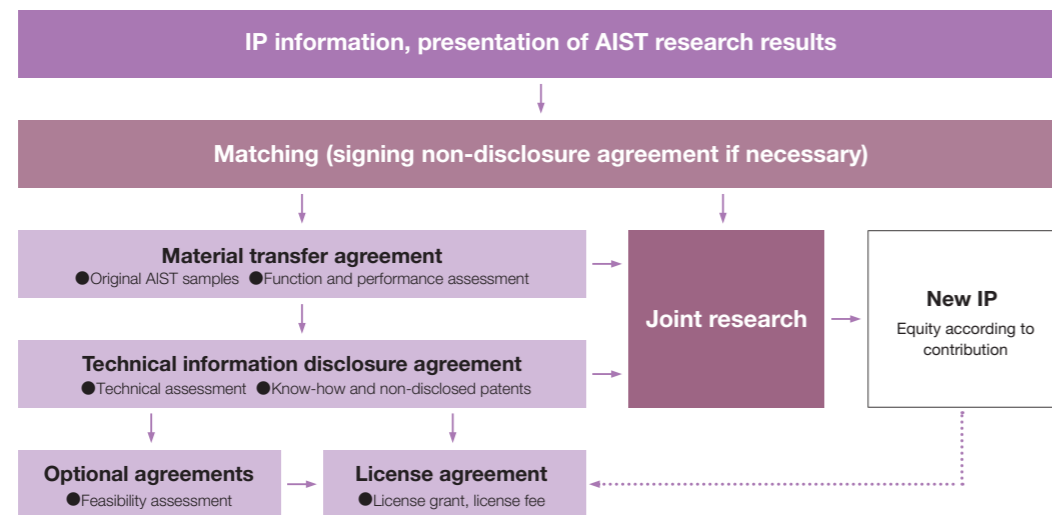
Deploying and developing human resources

AIST promotes staff exchanges to facilitate the development and utilization of personnel who will produce innovation. AIST's efforts to develop training activities include AIST Innovation School and AIST Design School.

Cross-appointment Program

To create a cross-institutional research system, in November 2014 AIST established a cross-appointment program. This program allows a researcher to enter into employment contracts with multiple institutions and he/she can work in research, development, and education according to his/her role in each institution. By accepting faculty members from universities and other institutions and transferring AIST researchers to universities and companies, AIST is expected to increase the mobility of human resources and, as a core institution for technology transfer or "bridging" research, smoothly promote "bridging" to create

practical applications and new industries by taking advantage of the excellent technological seeds generated from basic research at universities and other institutions.

We accept 30 researchers from 11 universities, 2 private companies, and 2 institutions, and send 12 researchers to 6 universities and 3 private companies and 2 institutions. (As of April 2023).

AIST Research Assistant Program

With the purpose to develop human resources with world-class, high-level expertise and high competency to perform in diverse situations in society, AIST has established the AIST Research Assistant Program to hire graduate students with high levels of ability. This program allows talented graduate students to focus on their research activities to earn a degree without financial concerns.

In addition, it gives them opportunities to participate in AIST's R&D activities of high social needs, from which they can develop the ability to plan and conduct advanced research appropriately at the professional research site.

In FY 2022, 411 students in graduate programs engaged in R&D at AIST.

●**Employment requirements for AIST Research Assistants** (as of June 2023)

Candidate	Graduate students in master's programs	Graduate students in PhD programs
Requirements	R&D abilities that may help to promote AIST's R&D projects and capability to work independently under staff guidance.	Superb R&D and paper-writing abilities that contribute highly to the promotion of AIST R&D projects and capability to work independently under staff guidance.
Days of employment	Avg. 4-14 days/month	Avg. 10-14 days/month
Salary	1,500 yen/hour (approx. 80,000 yen/month for 7 working days)	1,900 yen/hour (approx. 200,000 yen/month for 14 working days)
Number of graduate students employed in FY 2022	411	

Technical Training

The technical training is a program in which AIST accepts researchers, engineers, and students from companies, universities, and public research organizations for defined periods and provides them with an opportunity to study technologies under the instruction of AIST researchers. The program may also be used for the purposes of short-term research training (internships) and educational programs for academic credits, which are both designed mainly for university students.

●**Partner Graduate School Program**

Using the knowledge and experience gained at AIST, AIST researchers teach as guest professors at graduate schools that have cooperation agreements with AIST. Within this program, AIST also provides technical training to the graduate students on the site of AIST. This program is deemed to be part of the students' academic degree programs.

●**75 universities with partner graduate school agreements** (as of June 2023)
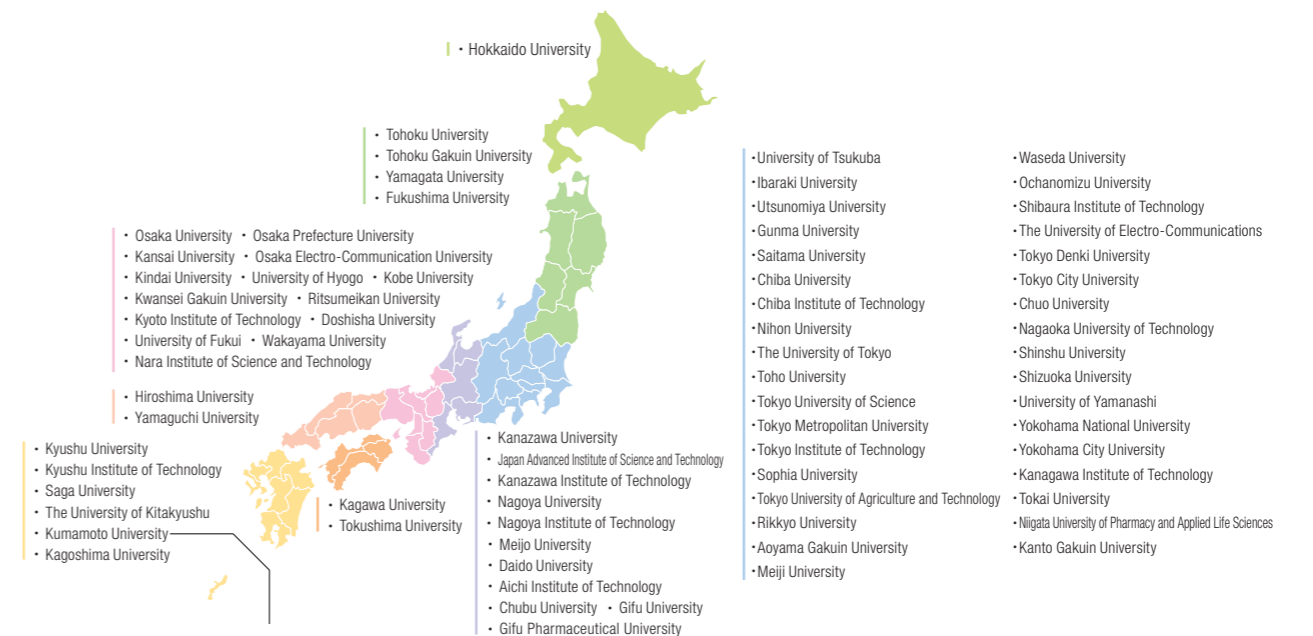
AIST Innovation School

AIST Innovation School aims to train human resources able to contribute to innovation. To address increasingly complicated social issues, we need to develop innovative technologies by integrating the ideas and technologies of AIST and external organizations. For this we need personnel who can play a central role in collaboration. AIST actively accepts postdoctoral researchers and graduate students, and provides lectures and training to learn and develop 3 skills: "research skills" that are learned through scientific and technological knowledge in specific areas of expertise, "cooperation skills" acquired through working with experts in different fields, and "resourcefulness" nurtured through communication, the ability to develop one's own career.

In FY 2022, we conducted lectures, seminars, and long-term business training as part of the training course of "human resources for innovation," and 12 postdoctoral researchers completed the course. We ran a half-year course online on "basic research skills" as an education program for graduate students in response to social conditions, and 45 students completed the program of lectures, seminars, and presentation outside AIST.

President's final lecture

●Curriculum of the Innovation School
1 Lectures and exercise at AIST
- Postdoctoral human resources expected by companies
- Intellectual property training
- Research ethics
- Companies and industries
- Research example cases at AIST (technology bridging research, goal-oriented research, integrated research, standardization etc.)
- Research project planning workshop
- Exercise on skills in presenting research in ways that can be understood by people from different fields
- Business manners, communication skills
- Exercise on how to develop one's career
- Coaching for collaboration between different fields
- Data science

2 Training at AIST
- Working on research in laboratories
- Experiencing research at AIST

3 On-the-job training at companies
(2 months or more, part of the training course of "human resources for innovation")
- Research development activities, productization, speed of technology development, importance of cost awareness at companies
- Experiencing teamwork, importance of collaboration with other departments

Since the school opened, more than 600 graduates of both courses have discovered new possibilities for themselves and are active in a variety of fields, including business, universities, and public research institutions.

●Expanding the horizons of young researchers
Through the lectures and communication among school students, the school students broadened their own perspectives, such as "It was meaningful to deepen exchanges with school students with diverse backgrounds," and "I was able to broaden my perspective on R&D activities by deepening my understanding of research in other companies through the training." The corporate training program broadened their perspectives through new experiences, such as "I was able to learn about approaches other than research for social issues," and "I became aware of how to organize my work more efficiently in consideration of my abilities, work environment, and time, which will be of great use in the future."

AIST Design School

The Design School is operated as a place where AIST staff and participants from companies and other organizations can learn together and cultivate the abilities (competencies) required for co-creation and social implementation. Today, we live in an era of VUCA (volatile, uncertain, complex, and unclear), where the issues to be addressed are unclear and rapidly changing. In the corporate world, it has become more important to think about "why to create" rather than "what to create," making it more difficult to launch a new business. To promote innovation, speed through agile development and clarifying the objectives, values, and culture of the organization and its constituent members to align them with the values of society, or to raise and co-create new values are required.

In FY 2022, 166 participants (16 in the master course, 26 in the short course, and 124 in the single-session course) took the course.

In February, we visited the Danish Design Center and KAOSPILOT, one of the most inspiring business schools in Denmark. Through the workshop on ethics in DX, there were deep discussions on ethics when developing DX.

●Competencies being cultivated
- Have a firm point of view and deep understanding of self (introspective, axial strength)
- Aware of cognitive limits, and able to explore the world from a new view point (bird's eye viewing ability, exploratory strength)
- Through rich dialogue, able to deeply empathize and understand others and society (dialogue skills, empathy)
- Able to co-create new values for society and lead the world (ability to co-create, ability to execute)
- Able to endure a situation with no solution (negative capability)

●Curriculum
- Experiential learning of dialogue that approaches essential values
- Creative leadership training in collaboration (concluded in December 2019) with KAOSPILOT in Denmark, which is considered the most radical business school
- Future insight with a professor from Hitotsubashi University
- Idea generation and prototyping with a professor from the University of Tokyo who taught for years at Britain's Royal College of Art (RCA)
- Project design through team project formation and practice

Strengthening international collaboration

AIST is building a global network with prominent research institutes around the world and is promoting efficient and effective research cooperation through international collaborative research, workshops and seminars, and personnel exchanges which include dispatching and inviting researchers.

Increasing Global Presence

AIST has been raising its international profile not only by conducting world-leading research but also by strengthening collaboration with overseas research institutes and through inter-organizational personnel exchanges. As an effort to enhance collaborative relations with overseas institutes, AIST, together with RIKEN, organized the Eleventh Global Summit of Research Institute Leaders in October 2022. The purpose of this summit was to bring together the heads of the world's leading research institutes to discuss the future of science and technology, the role of each institute, and collaboration among research institutes. The theme of this year's conference was "Diversity of Funding," and 13 research institutions from 9 countries and regions around the world participated. In his opening remarks, President Ishimura stated that while funding methods differ depending on the mission and position of each institution, he hoped to make the conference a meaningful one by sharing each institution's unique approaches and incorporating good ideas from each other. After a speech by Dr. Iain Stewart, Director of the National Research Council (NRC) of Canada, the participants discussed the efforts of each organization to diversify funding sources.

There was also a lively discussion on the need for brain circulation to accelerate international collaboration. During the conference, the importance was confirmed of "research being conducted beyond research fields and national boundaries during the Covid 19 crisis" and "the need for each to fulfill a major role in order for research institutes to pursue a resilient society through science and technology."

Accepting Foreign Researchers

To enhance cooperation with overseas research institutes and to develop an international network of researchers, AIST welcomes foreign researchers from universities and research institutes around the world. In FY 2022, a total of 654 foreign researchers engaged in research at AIST.

By region, researchers from Asia accounted for more than 70% of the total, followed by Europe.

Strengthening International Collaboration to Address Global Issues

AIST has concluded Memoranda of Understanding (MOUs) on comprehensive research collaboration with 17 leading institutes representing various countries/regions worldwide and is engaged in the development of international research networks. In accordance with these MOUs, we aim to tackle global issues through joint research and personnel exchanges with overseas research institutes.

At the same time, through international collaborative research, workshops and seminars, and international conferences, AIST is forming a global network with influential research institutes in countries around the world and is promoting efficient and effective research cooperation. The year 2022 was an opportunity to deepen cooperation once again, as events that had long been held online gradually became face-to-face events. Specifically, we participated in the RTO's International Network CEO meeting held in Spain, where public research organization officials from various countries gathered, and introduced AIST's international collaboration at the 14th HOPE Meeting (hosted by JSPS), where young researchers from all over the world gathered. We also introduced AIST's efforts toward carbon neutrality at the Tsukuba Global Science Week 2022 (hosted by Tsukuba City).

Lecture at Tsukuba Global Science Week

● LIST of MOUs

● : Comprehensive MOUs　★ : Specific MOUs (excerpts)

EU
● Joint Research Centre (JRC)

Germany
● Fraunhofer-Gesellschaft (FhG)
● German Aerospace Center (DLR)
● German Research Center for Artificial Intelligence (DFKI)

Netherlands
● NMi Certin B.V the Nederlands Meetinstituut (NMi)

UK
★ The University of Sheffield

Switzerland
★ Swiss Federal Laboratories for Materials Science and Technology (Empa)

Portugal
★ Institute for Systems and Computer Engineering, Technology and Science (INESC TEC)

France
● Centre National de la Recherche Scientifique (CNRS)
● Commissariat a l'energie atomique et aux énergies alternatives (CEA)
★ International Bureau of Weights and Measures (BIPM)

Italy
★ National Institute of Geophysics and Volcanology (INGV)

Austria
★ Geological Survey of Austria (GBA)

India
★ Indian Institute of Technology, Hyderabad (IITH)
★ All India Institute of Ayurveda (AIIA)

Norway
● The Foundation for Scientific and Industrial Research (SINTEF)
● Institute for Energy Technology (IFE)

Finland
● Technical Research Centre of Finland (VTT)

Turkey
★ General Directorate of Mineral Research and Exploration (MTA)

Russia
★ Russian Scientific Research Institute for Metrological Service (VNIMS)

Mongolia
● Ministry of Mineral Resources and Energy (MMRE)

China
● National Institute of Metrology (NIM)

Korea
● Korea Research Institute of Standards and Science (KRISS)

Taiwan
● Industrial Technology Research Institute (ITRI)

Vietnam
● Vietnam Academy of Science and Technology (VAST)

Singapore
★ Agency for Science, Technology and Research (A*STAR)

Thailand
● Thailand Institute of Scientific and Technological Research (TISTR)
★ National Institute of Metrology (NIMT)

New Zealand
● The University of Auckland
★ GNS Science (GNS)

USA
● National Renewable Energy Laboratory (NREL)
● National Institute of Standards and Technology (NIST)
★ United States Geological Survey (USGS)
★ Brookhaven National Laboratory (BNL)

Canada
● National Research Council Canada(NRC)
★ Department of Natural Resources Canada (NRCan)
★ University of Toronto

Brazil
★ National Institute of Metrology, Standardization and Industrial Quality (INMETRO)

as of March 2023

🤝 AIST and Its Staff

Human rights

Many people work at AIST including officers, permanent employees and contract employees, as well as temporary employees, visiting researchers, technical trainees, contractors, visitors participating in industry–academia–government programs, and visitors participating in international programs. Everyone performs their duties with the awareness that it is important to have an attitude of respect and support for each other, regardless of title or position.

Protecting Human Rights in Research

AIST conducts ergonomic research involving human subjects, and medical research carried out in compliance with our Ethical Guidelines for Life Science and Medical and Health Research Involving Human Subjects.

In FY 2022, we implemented 175 research projects involving ergonomic experiments and 104 medical research cases.

Regarding an ergonomic experiment, the experimental protocol is reviewed based on opinions of the Committee on Ergonomic Experiments, which consists of external members, in accordance with the Declaration of Helsinki* to ensure the safety and scientific validity of the experiment. Likewise, a medical research experiment is reviewed in accordance with ethical guidelines based on the opinions of the Bioethics Committee consisting of external members.

When an experiment is performed, its participants are given thorough oral and written explanations of the details of the experiment and of their right to revoke consent. In this way, we ensure that their human rights and dignity are protected.

* Subtitled "Ethical Principles for Medical Research Involving Human Subjects," this is a code of conduct regarding human subjects adopted by the 18th World Medical Association General Assembly in Helsinki. Medical researchers have established this rule to regulate themselves with regard to medical research involving human subjects.

Harassment Prevention

Harassment stains a person's personality and hurts the dignity of the person being harassed and causes emotional distress and disadvantage. Not only the person harassed but also those who learn of the presence of harassment may suffer from reduced motivation to work, and the loss such as adverse effects on the results of research and resignation of talented people can be immeasurable. AIST has internal rules in place and provides training to make the workplace free of harassment.

●Harassment prevention measures
- AIST has in place rules for handling harassment and has defined procedures for the prevention of harassment.
- AIST provides counselors placed at AIST work sites with training on how to prevent harassment and provide counseling for harassment victims. We also hold a seminar on harassment prevention targeting all employees to enhance awareness.

●Counseling system

Each site has workplace harassment counselors. The counselors work to counsel, investigate, and mediate so that harassment victims are not distressed and suffer alone as a result of their experience. If the line of management or a counselor cannot address a harassment issue, it is possible to file to the Compliance Promotion Committee for the recovery from the disadvantages suffered. The committee reviews the issue and recommends the appropriate actions, which are then taken.

In addition, we have established an external counseling organization and made counseling by email, telephone or interview possible to make it easier to seek counsel and protect privacy.

●Training programs provided on harassment in FY 2022

Training program	Trainees	Objectives	Number of trainees in FY 2022
New Employee Training	New AIST employees	As part of training in the attitudes, basic knowledge, and skills required to perform their work, participants learn the basics of harassment issues and harassment prevention.	135
e-learning training for employees *including e-learning training for foreign researchers in English	Permanent employees, contract employees	As part of their learning of the basic organizational ethics and rules of AIST, participants learn the basics of harassment issues and harassment prevention.	6,873
Harassment Counselor and Sexual Harassment Counselor Training (online training and e-learning)	Harassment counselors	Participants learn the harassment prevention knowledge and skills required by counselors. These include face-to-face counseling techniques based on lectures.	35 115(viewing number)
Harassment Prevention Seminar (e-learning)	AIST employees who wish to attend the seminar	Participants learn the basics of harassment issues and harassment prevention.	118 (viewing number)

●Flow of the counseling process
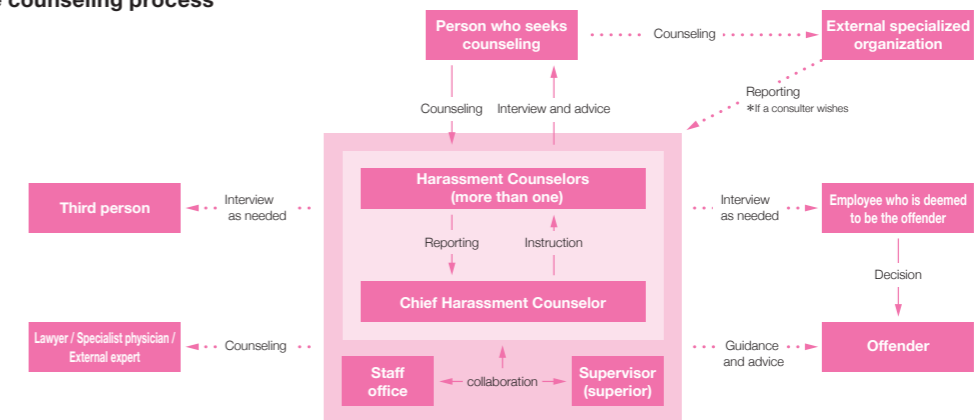
* Those who seek counseling can include people other than the employees involved (i.e. they can be the employee who is deemed to be the offender, the employee who is deemed to be the victim, or someone else, such as a colleague or a supervisor).
* Counseling can be sought by means of a face-to-face meeting, telephone call, email, letter, or fax. (contact by email or telephone with external specialized organizations)
* Seeking counseling causes no disadvantage.
* Adequate consideration is given to the protection of privacy, and any information acquired in the course of counseling is kept strictly confidential.

●Harassment counseling cases
(Persons)

	FY 2020	FY 2021	FY 2022
Sexual harassment	2	2	1
Power harassment	17	18	15
Total	**19**	**20**	**16**

Securing a diverse administrative staff to support R&D

In the future, as research and development diversifies, the administrative staff supporting it must also be diverse if it is to be implemented in society.

Although we have hired mainly new graduates for career-track positions in the past, we began hiring experienced workers in order to acquire personnel with diverse experience in the private sector, etc. In FY 2022, we hired 16 new people.

In addition, there are many tasks performed by AIST's headquarters and business organizations that would be more efficient if they were performed over a longer period of time by people with extensive work experience and responsibility, such as procurement, asset management, and employee welfare. We have a fixed-term regional employment (employing administrative staff without inter-regional transfers) system under which personnel who can handle such tasks are hired as fixed-term staff. In the past, only internal appointments were made, but from the viewpoint of securing excellent external human resources, the application requirements were relaxed and employment was implemented regardless of whether or not the employee had worked at AIST, and 28 employees were hired in FY 2022.

We also hired 17 specialists with expertise in information systems and security operations and international contracting in the promotion of industry–academia–government collaboration.

We will continue to accurately grasp the needs of society, acquire diverse human resources to respond to changes, and foster an environment in which they can play an active role.

Diversity

AIST aims to provide a working environment that embraces the values and ideas of employees with diverse attributes, including gender, age and nationality.

Activities of Intellectually or Developmentally Challenged Teams

AIST has set up Challenged Teams, made up of people with intellectual challenges and developmental challenges, at AIST Tsukuba, AIST Chubu and AIST Kansai. Each year, with reference to regional minimum wages, these people are employed on contracts at wages above the minimum wage for the region. They perform clerical support work, environment improvement work and the like with the support of instructors.

●AIST Tsukuba

The AIST Tsukuba Challenged Team was established in June 2008 and started with 3 team members, but has now grown to a larger team of 16 members, working on recycling and environmental maintenance work in AIST Tsukuba.

Work requested by various departments in the office is concentrated by the deadline, while other work is carried out according to various schedules.

We will continue to introduce the Barrier-Free Promotion Group outside the office, spread the activities of the Challenged Team within the office, and play an active role in a variety of situations.

Newly started calendar creation work

●AIST Tsukuba's business development image
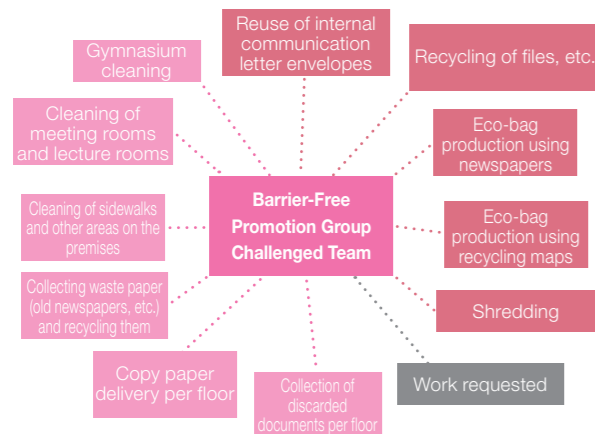
●AIST Chubu

The AIST Chubu Challenged Team, a seven-member team of five team members and two instructors, is primarily engaged in regular environmental beautification work on the grounds. Indoors, the team cleans meeting rooms and collects and sorts miscellaneous used paper, while outdoors, the team regularly cleans and weeds the grounds. We also play an active role in tasks requested by various departments, such as setting up event venues and picking up discarded documents.

Sorting corrugated cardboard and miscellaneous used paper

●AIST Kansai

The AIST Kansai Challenged Team presently comprises two members and one instructor, mainly working to beautify the premises. It contributes to maintaining trees and vegetation there by clearing weeds with a weeder, cutting high dead branches with a tree trimmer, and doing other tasks using various machinery and tools.

Weeding the premises

Measures to Promote Diversity in the Fifth Medium- to Long-term Plan

In March 2020, we established the Measures to Promote Diversity in the Fifth Medium- to Long-term Plan (April 2020–March 2025). Activities in FY 2022 are shown in the table below.

Subject	Goals	Main implementation in FY 2022
Achieving work-life balance	To promote measures to support work-life balance and create a work environment so that everyone working in AIST can work in a way that balances work and life which mitigates career interruptions resulting from life events	• We implemented "working at home system to support childcare" and "special measures for working at home as a COVID-19 countermeasure" in parallel. "The working at home system to support childcare" was used by 8 employees (4 men and 4 women). • We examined the introduction of an expanded teleworking system as a new type of work style from FY 2023 onward (a new teleworking system was introduced on May 8, 2023).
	To pervade attitudes unconstrained by established ideas of gender roles, to promote the provision of workplace environments that enable both men and women to get engaged in their childcare, and to widely adopt measures that support work-life balance	• We held online work-life balance lunch meetings (2 on childcare, 3 on the support system for hiring supplemental staff, and 1 on nursing care). • Based on the Action Plan for Supporting the Development of the Next Generation, we worked to create a workplace environment in which not only female employees but also male employees can easily use systems such as childcare leave, and provided information and promoted awareness of such systems within the institute.
	To disseminate information in the institute and improve the childcare and nursing care support systems to meet the needs of employees during maternity leave, childcare leave, nursing care leave, and after returning to work.	• We held online work-life balance seminars on balancing work with nursing care: nursing care costs (81 participants). • 22 employees were supported by the "support system for hiring supplemental staff" (20 for childcare support, 1 for prenatal support, and 1 for nursing care support). • Individually, we contacted employees who had returned from childcare leave, explained the systems in the institute, and listened to their requests through face-to-face and/or online interviews upon their wishes.
Promoting the active participation of female employees and expanding the recruitment of female researchers.	Aimed to support the promotion of female managers, to facilitate measures to improve staff motivation, raise awareness, and improve the workplace environment; to aim for the proportion of female managers to be 12% at the end of the period.	• The proportion of female management positions was 10.4% (45/432 persons) as of the end of March 2023. • We continued collaboration with the University of Tsukuba and IBM Japan established through MEXT's Subsidy Program for Human Resource Development for Science and Technology, "Initiative for realizing diverse research environments (leading type)," and held a cross-industry event for female researchers and engineers. Two female researchers gave presentations.
	To actively advertise employment opportunities for female researchers and to facilitate measures in accordance with the situation in each research domain.	• We organized informal meetings and lab tours with female researchers for female postgraduates and postdocs (30 participants from universities around Japan) and held online events for female middle and high school students. • We participated in seven events at invitations of universities and academic societies and introduced the research jobs and AIST. • 134 women applied for research posts in response to recruitment in FY 2022.
	To maintain the proportion of women in research posts at or above 18% over the five-year period; hiring of administrative staff with the aim of achieving similar proportions of women and men in administrative posts.	• The proportion of women who were hired as researchers (new entrants) in FY 2022 was 14.4% (14/97 persons). • The proportion of women who were hired as administrative staffs (new entrants) in FY 2022 was 65.7% (23/35 persons).
Recruitment and support for onboarding and work of foreign researchers	To raise foreign researchers' awareness of AIST by providing information to foreign researchers on the public English website in order to support the recruitment and acceptance of excellent foreign researchers.	• Information on the public English website was updated. • The proportion of foreign employees (foreign nationalities) who were hired as researchers in FY 2022 was 13.4% (13/97 persons).
	AIST International Center (AIC) focuses on residence and living support services for foreign researchers, to understand the needs of regional research bases and hold seminars in English on work in the institute etc. in cooperation with the relevant departments.	• AIC collaborated with relevant departments to provide foreign researchers and onboarding mentors seminars in English (twice a year), Japanese language courses, and information dissemination for foreign staffs (monthly newsletters). • With the aim of supporting the work of foreign researchers, we have encouraged the departments in charge of the institute's system to deliver work information in English, and have implemented initiatives such as proofreading services by English native speakers. • We handled 130 consultations on various subjects and 9 inquiries about the Ministry of Justice's points-based preferential immigration system for highly skilled foreign professionals.
Career development	To provide career counseling and lectures by experts, a mentor system, and consistent support from career path design to career development so that each employee can take a positive approach to their career.	• Lectures on diversity were included in internal training at various levels (induction training and unit manager training). • In addition to the diversity seminar on the theme of "Work Engagement," a curriculum on the same theme was also implemented in the career development support training (twice). • Career counseling service was conducted both in person and online, maintaining the system that allowed online counseling as in the previous fiscal year (number of consultations: 200).
Comprehensive promotion of diversity	To prepare suitable workplace environments for people with disabilities, to promote the hiring of people with disabilities and comply with statutory employment rates, and to support people with disabilities to be active members of society	• The number of employees with disabilities was 135 out of 5215.5, achieving the statutory rate of 2.6%. • We participated in an interview meeting with an organization supporting employment for people with disabilities sponsored by Tsukuba City, presented the employment status of the disabled at AIST, and organized tours for special-needs schools. • Set handrails along the entrance slope, installed computer stands and adjustable desks, and renewed stairway evacuation cars for the physically disabled. • We introduced screen voice reading software for the visually impaired.
	To nurture awareness of diversity throughout the institute to promote acceptance and understanding of people with diverse genders, ages, nationalities, etc.	• To further raise and spread diversity awareness, the President's message was sent out and a video message from the Vice-President in charge was distributed.
	Guided by the Diversity Promotion Committee, to apply the PDCA cycle to promotion measures, consider necessary policies, and promote diversity throughout the institute.	• In order to implement the action plan based on the Law for Promotion of Women's Activities and Measures to Support Development of Next-Generation, we included items related to diversity promotion in the engagement survey and investigated the awareness of the term diversity and inclusion (D&I), awareness of career development, and awareness of work-life balance.
	To contribute to the Diversity Support Office (DSO) as a key member organization, sustain cooperation with other organizations and contribute to society.	• Continued collaboration with the University of Tsukuba and IBM Japan, which was established through MEXT's Subsidy Program for Human Resource Development for Science and Technology, the "Initiative for realizing diversity research environments (leading type)," and held working groups to exchange information and discuss initiatives. • We continued to coordinate the activities of a diversity support network of 20 research and education institutions in Japan (DSO), and in October 2022, became the representative organization of DSO. We have been exchanging information such as case studies, and improving internal systems.

Initiatives to increase the take-up rate of childcare leave for men

Although the number of male AIST employees taking childcare leave has been increasing every year, in FY 2021, only about 25% of the eligible employees took childcare leave. Therefore, the following initiatives were taken to increase the take-up rate.

For employees, we held an information exchange meeting with five male researchers who have taken childcare leave in the past few years to share their experiences. All of them were glad that they have taken childcare leave. On the other hand, many of them commented that the duration, number of times, and other aspects of taking such leave vary from person to person and it should be decided after careful discussion within their family. Participants commented that it was a valuable opportunity to hear from men who have taken childcare leave, and that they wished there would be more time talking about it. As there were comments that actual case presentations are effective in increasing the take-up rate, we plan to hold such meetings in the future.

With the aim of increasing the rate of male employees taking childcare leave at research and educational institutions, the Diversity Support Office (DSO), of which AIST serves as the chair of the organization, held a regular information exchange meeting (February 2023) on the topic of "Initiatives to support male employees' participation in childcare and publication of the take-up rate of childcare leave." As a new attempt, a questionnaire was sent to all DSOs in advance of the meeting to provide a forum for sharing the details of each organization's efforts. In particular, since the announcement of the childcare leave take-up rate is about to be made, there was a lively exchange of practical opinions on how to calculate the take-up rate, how to confirm the intention, and other issues, making this a beneficial opportunity to exchange information.

Safety and health

As would be expected in laboratories, AIST uses substances and equipment that may affect the human health and the environment, such as various chemical substances, high-pressure gases, radioisotopes, genetically modified organisms, nanomaterials, laser equipment, and various experimental equipment. Accordingly, AIST creates a work environment in which all people working there can do so in a safe and healthy manner.

Occupational Safety and Health

●**Safety and Health Committee and webcasting of "Summary of Incidents and Near Misses (Hiyari-Hatto) and Safety and Health Management" videos**

The Safety and Health Committee meetings attended by labor and management representatives are held monthly to discuss safety and health issues. Each month, "Summary of Incidents and Near Misses (Hiyari-Hatto) and Safety and Health Management" providing previous incidents information and danger experience education streamed on the intranet. By making it mandatory for all employees to view the online streaming, we work on increasing safety awareness.

●**Establishment of Safety and Health Guidelines**

Safety and Health Guidelines set out precautions on handling hazardous chemicals and high-pressure gas cylinders, disposal of research wastewater, fire, and disaster prevention.

Serving as the basis for employee safety education and for laboratory work, these guidelines are reviewed and revised as needed.

●**Emergency preparedness**

AIST conducts disaster, fire, and other security drills so that we can promptly respond to emergencies such as disasters and accidents, thereby minimizing damage. We also perform safety confirmation drills using our safety confirmation system* for quick and smooth grasping of the safety of employees.

To ensure a means of communication with each regional research base in the event of a disaster, we also conduct emergency communication drills using emergency radiotelephones installed at those bases. As part of preparedness for disasters such as large-scale earthquakes, we stockpile food, rescue equipment, and other emergency supplies, which are inspected and refreshed on a regular basis.

* In the event of a disaster, the safety confirmation system automatically sends bulk safety confirmation emails to executives and employees. It automatically collects the results and displays them on the web.

●**Preventing occupational accidents**

In the event of a work-related accident, an investigation and analyses are conducted to determine the cause, and recurrence-prevention measures are implemented. The information on accidents is communicated to all employees to prevent similar accidents.

AIST holds a Safety Management Report Meeting connecting Environment and Safety Headquarters with each research bases using a web conference system to share information on accidents and near-miss incidents. The aim is to share details of recurrence prevention measures and thus improve safety and health.

The number of occupational accidents in FY 2022 was the same as in FY 2021, and none of them were serious. To address this situation, we provide safety education to make sure that appropriate protective equipment is worn, prepare work procedure manuals and risk assessment for high-risk tasks, and enhance sensibility by conducting risk prediction activities to foster safety culture.

●**Safety education**

AIST accepts many researchers, engineers and students from businesses, universities and the like for cooperative research, technical training and so forth. With a view to preventing accidents, AIST runs various safety training programs and classes, both for employees and for visitors from other organizations. Safety education provided when employees are hired and when there is a change in work details is managed by an internal safety education management system, which allows learning history and program contents to be checked as needed.

Health Management and Mental Health

General and special medical examinations are performed in spring and autumn every year. We strive to increase the percentage of employees who undergo medical examinations by raising awareness that they are required to take these examinations, including health screening. As follow-up care after medical examinations, an industrial physician and industrial health staff provide health advice detecting and preventing employees' health disorders and illnesses in their early stages. In response to employees' diverse needs, we also provide health information through health support seminars to raise health awareness, and thus provide support to improve the performance of individual employees and AIST as a whole.

To address mental health issues, we have developed a unified Mental Fitness Program in accordance with the directives and guidelines of the Ministry of Health, Labor, and Welfare. Four programs based on the Mental Fitness Program are implemented in a continuous and planned way. They focus on (1) self-care; (2) line care through implementation of education and training and seminars; (3) care by in-house industrial health staff and others through face-to-face counseling with an industrial physician and industrial health staff and support in returning to work; and (4) care by external resources through the use of external mental health organizations.

We use a stress check system (once a year) to encourage awareness of stress situations of staff and to promote workplace improvement to create a comfortable workplace. By doing this, we are making efforts to strengthen measures to prevent staff from suffering mental health disorder. For the entire AIST, the average stress score has been lower than the national average since the stress check was introduced.

●**Outline of return to work program**

| Submission of medical certificate for absence from work | → | Start of leave of absence from work | → | Care during absence and follow-up during preparation for return to work
• Monthly meeting with an industrial physician
• Implementing return-to-work plan * | → | Return to work | → | Follow-up after return to work
• Meeting with an industrial physician twice a month (for 6 months) |
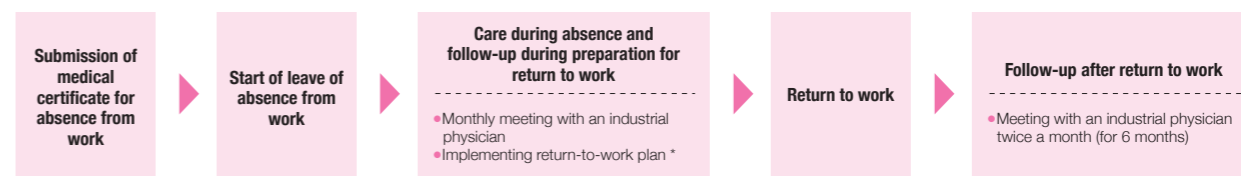
*Depending on the length etc. of absence from work

Toward an AIST that Draws Out the Strength of Each and Every Employee

Awareness of the issues

To improve organizational performance, it is necessary to make the workplace a place where all staff members are motivated to work, in other words, to improve engagement. In order to understand the state of engagement in the organization and link it to improvement measures, we started an engagement survey in FY 2021.

Engagement survey shed light on certain issues

An annual engagement survey of staff and contract employees is conducted to identify organizational strengths and challenges.

Based on the results of the eNPS* in the FY 2022 engagement survey, we feel that the state of engagement at AIST is not ideal and that we need to work on further improving engagement.

Of the six items in the question content, the results related to (1) own work, (3) relationship with surroundings, showed strengths in "high expectations and satisfaction with work content" and "good communication within the department." On the other hand, results related to (2) own growth, (3) relationship with surroundings, and (4) organizational philosophy identified the following issues: "there is room for improvement in the relationship between management and staff," "there are concerns about the career path," and "organizational philosophy is not fully penetrated." To resolve these issues, we are promoting initiatives to support proactive career development and increase opportunities for dialogue between staff and management.

Strengths of AIST

1 Good relationship with surrounding people (especially among staff)

2 High interest in the nature of the work

AIST Issues

1 There is room for improvement in the relationship between management and staff.

2 Difficult to draw a career path

3 Insufficient permeation of organizational philosophy

Q. Can you recommend AIST to others as a great place to work?

○Survey period: mid-December 2022 to mid-January 2023 ○Respondents: staff and contract employees
○Overall response rate: 77%. Questions: (1) own work, (2) own growth, (3) relationship with surroundings, (4) organizational philosophy, (5) organizational culture, and (6) working conditions.

● **Full-time employees eNPS index: -56**

recommenders **5.62%**

| critics 61.50% | neutrals 32.88% | |
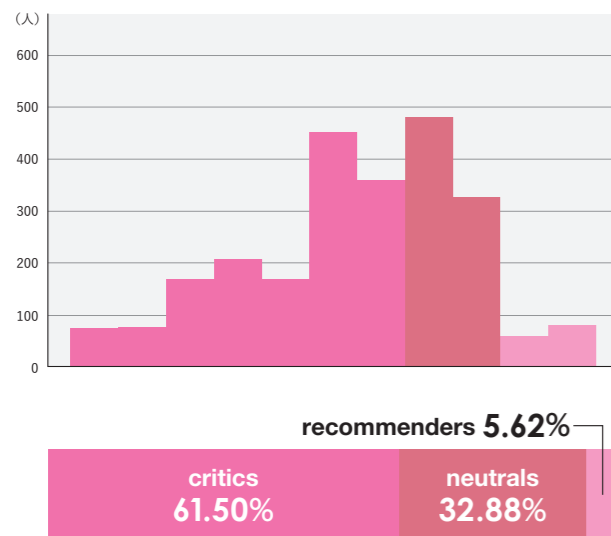
● **Contract employees eNPS index: -51**

recommenders **7.78%**

| critics 58.41% | neutrals 33.82% | |

Measures to improve issues

● **Implementation of an in-house recruitment system and 1-on-1 meetings for proactive career development**

Instead of transfers based on organizational directives as in the past, we introduced an in-house open recruitment system (implemented in four operations in FY 2022) to support the independent career development of individuals and assign the right person to the right position in accordance with their wishes. In addition, to increase opportunities for dialogue between supervisors and subordinates, we encourage 1-on-1 meetings at least four times a year to support the growth of each employee.

● **Increased opportunities for dialogue with management**

"AISTalk," in which management directly communicates with staff, was initiated and held 131 times in FY 2022. The purpose is for management to carefully explain the "Fifth AIST Management Policy" and to listen to the frank opinions of staff members and feedback from the field, so that they can be utilized in the future management and organizational operation of AIST. This will lead to improvement in the two-way relationship of trust and engagement between management and staff.

* eNPS is an abbreviation for Employee Net Promoter Score, an indicator of employees' attachment to and trust in their workplace and company. Scores are calculated by classifying those who scored 9 to 10 as "recommenders," those who scored 7 to 8 as "neutrals," and those who scored 0 to 6 as "critics," and then dividing the score by [ratio of recommenders - ratio of critics].
[Note: The total may not sum up to 100% because of rounding to the second decimal place.]

Community Involvement

Hokuriku Digital Manufacturing Center established.

● What is the Hokuriku Digital Manufacturing Center?

The Hokuriku Digital Manufacturing Center (hereinafter referred to as "Hokuriku Center") opened on May 21, 2023 in Sakai City, Fukui Prefecture, as the 12th research center of AIST's nationwide network. To promote regional innovation, the center will promote collaboration with local businesses, universities, and public experimental and research institutions, while leveraging AIST's strengths in conducting research in a wide range of fields. Through the use of digital technology, we will develop challenging manufacturing technologies that will add value to the metalworking and textile industries, which are major industries in the Hokuriku region.

Hokuriku Digital Manufacturing Center

● Opening Ceremony

The Hokuriku Center was established through the Regional Innovation Creation Collaboration Center Development Project.

Constructions of the building and trial operation of the equipment were made and an opening ceremony was held on May 21, 2023. The ceremony and preview were attended by Minister Nishimura of Economy, Trade and Industry, Governor Sugimoto of Fukui Prefecture, Mayor Ikeda of Sakai City, Diet members elected from Fukui Prefecture, and many people from the three Hokuriku prefectures and related organizations. Minister Nishimura of Economy, Trade and Industry expressed his high expectations and commented, "I hope that the establishment of the new AIST research center in the Hokuriku region will open up a new future for manufacturing that combines manufacturing and digitalization. AIST has great resources in semiconductors, renewable energy, AI, etc. I hope that everyone in the Hokuriku region will also use AIST's nationwide network of 12 locations through the Hokuriku Digital Manufacturing Center."

● Research Themes and Future Initiatives

Two new research teams of the Industrial CPS Research Center will be established at the Hokuriku Center, and will work on research that takes advantage of the unique characteristics of the Hokuriku region.

1 Development of highly functional clothing using smart textiles (Smart-textile Research Team)

We will develop textiles and clothing with various measurement functions, such as posture, respiration, and heart rate, by utilizing knitting and printing molding technologies for conductive materials. This will lead to the social implementation of smart textiles that measure movement and physiology, and enable the co-creation of experience-based value between the manufacturer and the user.

2 Development of metalworking technology utilizing 3D printers and evaluation technology for processed products (3D Manufacturing and Evaluation Research Team)

We will introduce metal 3D printers for manufacturing eyeglasses, ornaments, precision metal parts, etc., make prototypes, and evaluate them utilizing shape measurement, etc. In addition, through remote calibration of measuring instruments utilizing DX technology, we will perform high-precision measurement and evaluation utilizing Tsukuba's national standards.

In addition to advancing these research themes, AIST will serve as a collaborative hub connecting research centers across Japan to address various issues in the Hokuriku region, with the aim of creating innovation in the Hokuriku region.

Hokuriku Digital Manufacturing Center
https://www.aist.go.jp/hokuriku/index.html

Development of a center for prototyping, evaluation, and human resource development related to storage batteries (AIST Kansai)

● Human resource development for batteries in the Kansai Region

AIST Kansai houses the Research Institute of Electrochemical Energy, which is staffed by researchers who are conducting cutting-edge battery research. It is also home to the Lithium Ion Battery Technology and Evaluation Center (LIBTEC), one of Japan's leading research centers for storage batteries, which brings together a wide range of stakeholders, including companies and universities. Currently, the center's functions are being enhanced with the addition of new storage battery prototype manufacturing facilities and advanced analytical equipment.

The Kansai region is home to numerous battery manufacturers and other production bases and storage battery-related industries. In August 2022, the Kansai Storage Battery Human Resource Development Consortium (hereinafter referred to as the "Consortium") was launched in this Kansai region, with the participation of industry, educational institutions, local governments, and support organizations. The purpose of the Consortium is to promote the development of human resources and the securing of human resources related to batteries in order to achieve the numerical targets for battery production set forth in the Strategy for Storage Battery Industry by the Ministry of Economy, Trade and Industry.

AIST Kansai, together with the Consortium, is preparing for a human resource development project that will begin at full scale in FY 2024. Together with the Consortium, we will promote efforts to develop and secure human resources and contribute to the sustainable development of the storage battery industry.

● Consideration of human resource development program for storage battery

AIST Kansai, a research and development center for storage batteries, will conduct an educational program that will also utilize actual equipment, including the battery manufacturing facilities and advanced analytical equipment that will be additionally equipped as described above. This program is primarily intended for university and graduate students, postdoctoral researchers, and corporate personnel. The objective of the program is to foster and produce technical personnel who can play an active role in product and technology development, battery cell design, battery evaluation, and quality control at manufacturers. Specifically, we plan to provide on-the-job training in which trainees will engage in research and development under the guidance of researchers who are advancing cutting-edge battery technology research. The educational program will also include a mixture of classroom lectures and practical training.

1 Classroom lecture: Develop basic skills and get an overview of battery manufacturing.

In the basic skills training course, leading university faculty members are invited to give lectures on the basic content required for battery engineers.

In the introduction to battery manufacturing course, lecturers from battery manufacturers are invited to give lectures on more practical techniques such as cell design, fabrication, and characterization.

2 Practical training and observation: Battery manufacturing practice and battery evaluation and analysis practice

In the battery manufacturing training, students will learn how to make batteries under the guidance of a former battery manufacturer, using the newly established battery manufacturing facilities while taking advantage of LIBTEC's knowledge.

In the battery evaluation and analysis practice, students will conduct charge-discharge tests and practice utilizing equipment that can perform advanced analysis as well. In addition, a visit to a safety testing and evaluation organization is planned.

Other educational programs for high school and technical college students will also be offered by the participating institutions in the Consortium. AIST Kansai will provide practical training in the manufacture of small batteries. The program is designed to provide high school and technical college students, who are expected to play an active role with specialized skills and advanced technology, with hands-on experience of a series of battery manufacturing processes and their operation. This will provide an opportunity to deepen their interest in storage batteries.

Battery material analysis

Prototype storage battery (8 Ah)

📖 Basic Information about AIST

Future Outlook

Under the vision "Create the Future, Collaborate Together," AIST is pursuing research activities to give the world technologies that can enable a sustainable society, address social problems, and generate economic development.

Aiming to Fulfill the AIST Mission

AIST Management Policy

AIST adopted the 5th Term Management Policy in September 2021. Backcasting from a future vision in which AIST continues to be at the core of the innovation ecosystem for the whole of Japan in the 7th Term and beyond, this management policy sets goals of the 7th Term being a period of evolution, the 6th Term being a period of growth, and the 5th Term being a period for building a prototype of the innovation ecosystem. To realize this future vision, we will maximize the value of AIST while accelerating social implementation.

1. Mapping the 5th Term Management Policy with a view to the long-term prospects of AIST

1 Maximizing the value of AIST
By switching from a cost accumulation basis to a value provided basis for cooperative research with private businesses and the like, we will produce a virtuous cycle in which capital investments in AIST increase, enabling strategic investment in subsequent research infrastructure and human resources.

2 Business scale in the 7th Term and beyond
To accelerate social implementation, we aim to double the scale of business of AIST Group, which includes external corporations, from the current business scale (about 100 billion yen) to 200 billion yen. We are aiming for private funds to then be of the order of 60 to 70 billion yen (bringing the ratio of private funds, public funds, and subsidies close to 1:1:1).

3 7th Term and beyond (from FY 2030)
Mapped as a period to "evolve the national innovation ecosystem with AIST at its core" with the tagline "continuing trust for AIST from society," the aims are for "the coalition of the strong model with AIST at its core to be a key for industrial growth in Japan" and that "new industries created by diverse coalitions drive regional economies."

4 6th Term (FY 2025 to FY 2029)
Mapped as a period to "grow the national innovation ecosystem with AIST at its core" with the tagline "AIST leaps ahead," the aims are "coalitions of the strong turning social implementation models into reality" and that "diverse coalitions lead regional innovation to create new industries."

5 5th Term (FY 2020 to FY 2024)
Mapped as a period to "prototype a national innovation ecosystem with AIST at its core" with the tagline "establish the AIST brand," the aims are "coalitions of the strong with AIST at its core" and that "diverse coalitions lead regional innovation."

2. Overview of the 5th Term Management Policy

In the 5th Term, we aim to increase the value of AIST by strengthening the core functions of a national innovation ecosystem and improving the team strength of AIST. In this way, we aim to build a prototype of the national innovation ecosystem and establish the AIST brand.

Realizing the building of this prototype starts with switching from the cost basis to value provided. Consequent to strategic investment in research infrastructure and human resources, the aim in the 5th Term is for the business scale of the whole AIST Group including external corporations to reach around 120 billion yen, about 20 billion yen of that being private capital.

(1) Strengthening the core functions of the national innovation ecosystem
- We will further enhance AIST's strengths by selecting and concentrating management resources, creating value through system design, and promoting unique research base equipment.
- We will improve social implementation of research outcomes by using the Dejima approach (setting up external corporations and the like) to accelerate social implementation, strengthening AIST-initiated startups (helping to create unicorns), and improving the one-stop system.
- We will enhance AIST's potential by expanding next-generation research with consideration for market prospects and improving international deployment of R&D outcomes.

(2) Improving the team strength of AIST
- Manifesting AIST's team strength to the greatest extent is important for increasing the value of AIST. We will improve each of the elements that make up AIST's team strength: 1) research strength, 2) organizational strength and 3) human resources.
- Improving engagement based on two-way trust and assistance between staff and the organization is also important as a foundation for the three elements of AIST's team strength. As key points in improving engagement, we will work on (1) building relationships of trust, (2) sharing a vision, (3) providing fulfillment, (4) preparing suitable workplaces, and (5) supporting personal development.

●**Overview of the 5th Term Management Policy**

5th Term targets: Solving social problems and strengthening industrial competitiveness		
Prototype a national innovation ecosystem with AIST at its core		**Establish the AIST brand**
Establishing multiple coalitions of the strong with AIST at the core	Multiple diverse coalitions to lead regional innovation	Switch from cost basis to value provided. Consequent to strategic investment in research infrastructure and human resources, private capital invested in the whole AIST group including external corporations to be approx. **20 billion yen**

Increase the value of AIST			
Strengthen ecosystem core functions	● Select and concentrate management resources ● Create value through system design ● Promote unique research base equipment	● Use the Dejima approach (setting up external corporations, etc.) to accelerate social implementation ● Strengthen AIST-initiated startups (help to create unicorns) ● Improve the one-stop system	● Expand next-generation research with consideration for market prospects ● Improve international deployment of R&D outcomes
Improve team strength	Improve organizational strength / Improve research strength / Improve human resources		
	Improve engagement		

Appropriate and trustworthy organizational governance

AIST ensures appropriate management of all operations to make full use of AIST's capabilities and achieve AIST's missions.

Promotion of Compliance

To raise employee awareness of compliance and take our organizational culture to the next level, AIST undertakes the following measures to strengthen compliance:

Compliance initiatives
1 In principle, a Compliance Promotion Committee meeting is held every week to gather risk information and determine how to address it. Risk information is also shared at regular in-house meetings to prevent recurrence.
2 In the event of an allegation of whistleblowing or research misconduct, an investigation committee is formed to investigate the matter, the results are reported to the President, and necessary corrective measures, etc. are taken.
3 Continuing from last year, AIST has set December as the Compliance Promotion Month to strongly raise awareness of compliance of each executive and staff and reliability of AIST. Specifically, messages from the President and others are transmitted, special training for researchers and clerical staff, in-house solicitation of slogans, and posting on posters are conducted.
4 In addition to e-learning courses for all staff, we provide compliance education as part of training for newly hired employees and management training for unit directors and research group leaders, with content adjusted to each group of participants.
5 In an effort to instill compliance, we post monthly compliance posters titled "Compladayori," created under a different theme for each month. This is aimed at increasing employee awareness of compliance and urging them to be vigilant at work.

●Addressing research misconduct

1 In the event that research misconduct is alleged to have occurred, AIST handles the allegations rigorously in accordance with the Research Misconduct Rules and other guidelines.

2 In order to become a research and development organization trusted by society, a Handbook on the Code of Conduct for Researchers was made and distributed to all the staff that succinctly summarizes into "5 minds" the ethics and points of attention needed in conducting research.

3 We encourage employees to use the online plagiarism detection tool, which was introduced to help prevent inadvertent self-plagiarism and other forms of research misconduct. The number of times used was 483 in FY 2015, the first year it was introduced, and in FY 2022, the number increased about 3 times to 1,479.

●Response to research misconduct at AIST

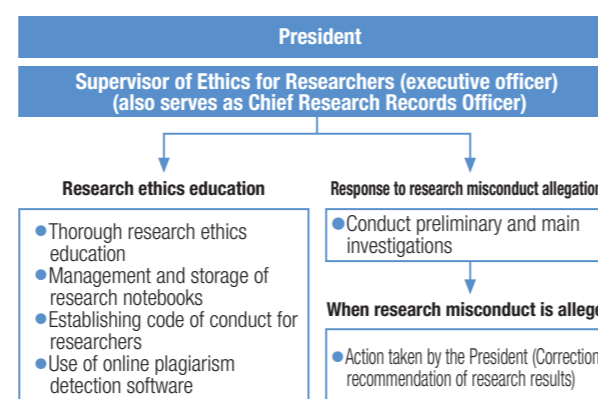| President |
|---|
| **Supervisor of Ethics for Researchers (executive officer)** (also serves as Chief Research Records Officer) |

Research ethics education	Response to research misconduct allegations
●Thorough research ethics education ●Management and storage of research notebooks ●Establishing code of conduct for researchers ●Use of online plagiarism detection software	●Conduct preliminary and main investigations
	When research misconduct is alleged
	●Action taken by the President (Correction recommendation of research results)

●Research information management

As an institution conducting scientific and technological R&D financed by public research funds, AIST has been strongly called upon to take steps to prevent research misconduct—such as fabrication, falsification, and plagiarism—by the guidelines issued by the Ministry of Education, Culture, Sports, Science and Technology and the Ministry of Economy, Trade and Industry.

Accordingly, AIST has set rules of records management as a concrete measure and has made it obligatory to record research information. Regarding research information that needs storing such as research notebooks, we have made it obligatory to register the information on the research notebook recording system and be validated by superiors. In addition, for thorough management of research information, we have restricted taking out research notebooks and copies when resigning, and have set guidelines for handling research information other than research notebooks.

AIST will continue doing its utmost to ensure the integrity and transparency in research and will make effort to prevent research misconduct.

●Whistleblower System

AIST has established an internal reporting system not only for consultation and reporting of harassment and research misconduct, but also for early detection and correction of misconduct to maintain public trust in AIST and to ensure fairness in business operations.

In FY 2022, in light of the revision of the Whistleblower Protection Act, the "National Institute of Advanced Industrial Science and Technology (AIST) Regulations on Whistleblowing, etc." was revised to include provisions for the protection of whistleblowers.

●Collaboration with other organizations regarding compliance

The Compliance Special Committee was established in December 2017 to improve the risk management functions of corporations participating in the Council of National Research and Development Agencies (KOKENKYO). At the special committee, information related to compliance was shared and issues were discussed with participating corporations, a "Compliance Promotion Month" was set for all participating corporations, a unified slogan and poster were created and displayed, and compliance experts were invited to participate in training sessions.

Disclosure of Information and Protection of Personal Information

●Disclosure of information

To increase the transparency of AIST's activities and fulfil its accountability requirements, AIST proactively discloses information on its website and by other means in accordance with the Act on Access to Information Held by Incorporated Administrative Agencies (implemented October 1, 2002).

●Information Disclosure and Personal Information Protection Desk

Requests for information disclosure in accordance with the Information Disclosure Act and the Personal Information Protection Act can be made through these desks and the website of AIST Tsukuba and other regional research bases. Each desk also provides help on the procedures for disclosure and personal information protection. Only requests for information disclosure can be made through the website.

●Protection of personal information

In accordance with the Act on the Protection of Personal Information enforced on April 1, 2022 which integrated three acts, the Act on the Protection of Personal Information, the Act on the Protection of Personal Information Held by Administrative Organs, and the Act on the Protection of Personal Information Held by Incorporated Administrative Agencies, AIST has revised the Privacy Policy and Rules on Protection of Personal Information of the National Institute of Advanced Industrial Science and Technology, to protect the individual's rights and interests while ensuring that activities at AIST are conducted properly and smoothly.

Every year, self-inspections by e-learning for personal information protection and information security are conducted, to raise awareness of the proper management of personal information relating to executives and staff and of information security compliance.

Internal Audits

At AIST, the Audit Office is deemed an independent organ that reports directly to the president. In collaboration with the auditor and the accounting auditor, the office endeavors to achieve (1) effective and efficient work, (2) observance of laws and ordinances governing AIST operations, (3) preservation of assets, and (4) reliable financial and other reports. Toward these ends, the office monitors whether individual operations function properly and efficiently and based on the findings, recommends improvements and other corrective actions. These internal audits are performed to support the auditees, not only by detecting and pointing out problems in work processes, but also by suggesting effective improvements based on mutual understanding that is built through thorough discussion on the problems.

● **Collaboration in audits**

	Internal audit ↔ Collaboration ↔ Auditor audit ↔ Collaboration ↔ Accounting auditor audit		
Scope of audit	● Operational audit ● Accounting audit ● Compliance audit	● Operational audit ● Accounting audit	● Accounting audit
Points of audit	● Activities as a whole ● Appropriateness of risk management and development and operation of internal control systems ● Improvement of work process efficiency	● Activities as a whole ● Decision-making by the President ● Creation and operation of internal control systems ● Appropriateness of financial statements	● Appropriateness of financial statements (effectiveness of internal control systems)

● **In FY 2022, audits were performed concerning the following topics:**

• On specific themes that urgently need auditing as well as cross-sectional themes, for administrative head-quarters, and research units, audits were conducted. While the audits confirmed that these operations were generally all being carried out properly, issues in terms of compliance, effectiveness, and efficiency of some were identified. The auditees concerned were advised to swiftly make suggested improvements and the improvements were confirmed.

• As information security audit and personal information management audit, audits were conducted on implementation status of various rules, and the audits confirmed that these matters were generally being handled properly.
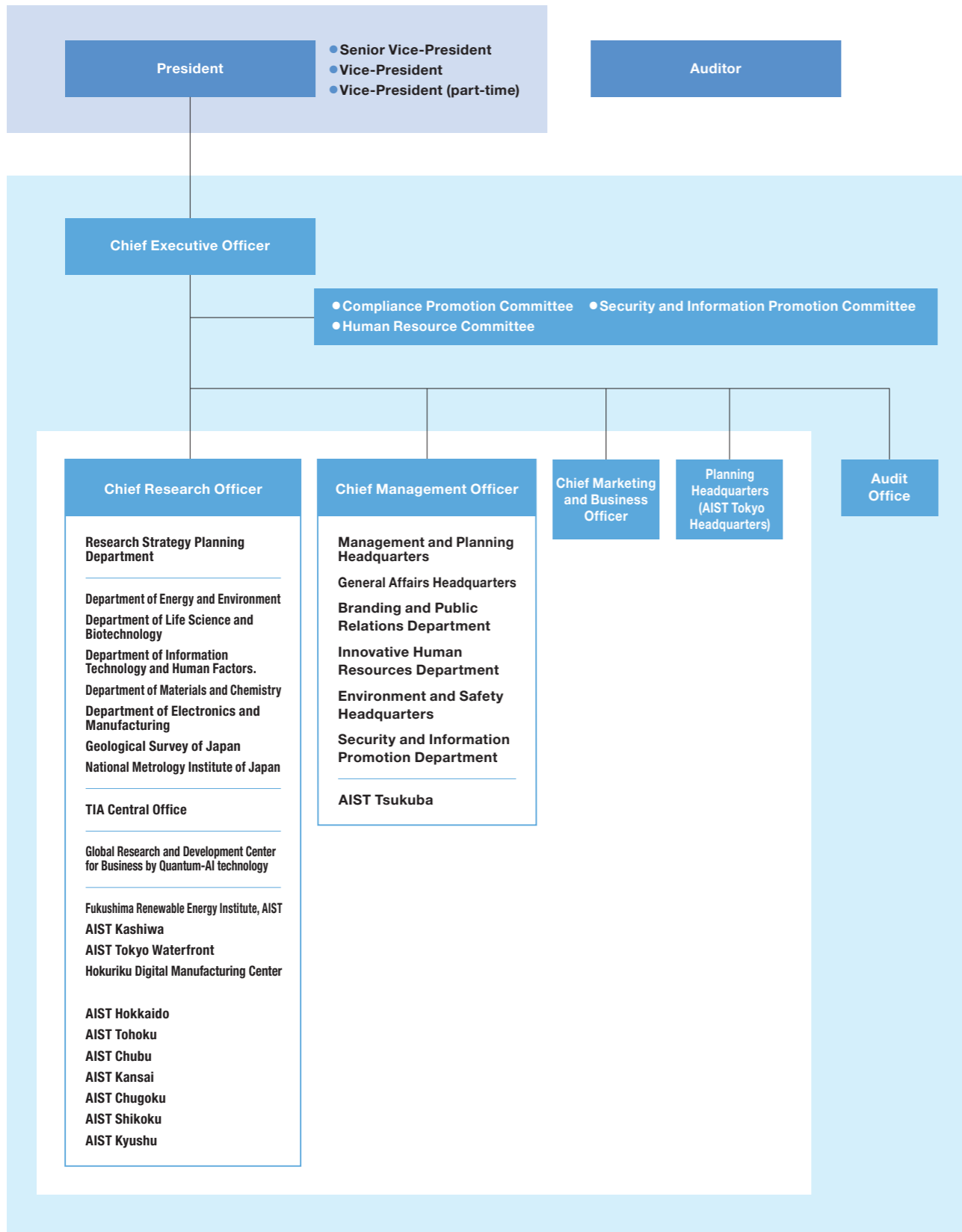
Fair Operating Practices

We conduct appropriate work management based on the law.

Subject	Purpose	Action in FY2022
Management of Conflict-of-Interest	Management of conflict-of-interest is conducted based on the rules for conflict-of-interest management.	• In order not to give the impression to society that individual profits from other parties in industry–academia–government collaborations are put before duty by executives or research responsibility, a conflict-of-interest management system is in place. 3,423 executives and employees who needed to declare their own status of conflict-of-interest all submitted their self-assessments. 3 employees who had particular concern for conflict-of-interest were interviewed by outside counselors to look into their activities. Additionally, after the Conflict-of-Interest Management Committee consisting of outside experts deliberated, they were notified of points of attention regarding promotion of industry–academia–government collaborations. • In order not to give the impression that we are putting profits before public responsibility, from FY 2020, we operate a management system for conflict-of-interest on a full scale. 52 corporate bodies with which we have close collaborative relations were targeted, and the Committee deliberated on our collaborative activities and procurement records. No problem was found.
Information Security	In order to ensure information security regarding information systems and important information, AIST implements measures that comply with Common Standards for Cybersecurity Measures for Government Agencies and Related Agencies.	● Information security measures • Conduct verification simulating actual cyber-attacks to confirm the effectiveness of security measures and monitoring systems • Consider a zero-trust configuration plan suitable for the institute's operations and formulate an implementation plan • Response to information security incidents by the Computer Security Incident Response Team (CSIRT) • Conduct drills based on business continuity plans in preparation for security incidents, etc. ● Information security training • Revised check items for post-training self-checks based on information security-related positions and usage status. ● Information security audit • Conducting information security audits for all departments
Implementation of Security Export Control	To maintain peace and security within the international community, AIST has tight security export controls in place in accordance with AIST's Rules on Security Export Control (internal rules and regulations), formulated based on the Foreign Exchange and Foreign Trade Act, thereby preventing AIST's technology from being used for the development of weapons of mass destruction.	Through (1) dissemination of the latest information on legislative amendments within AIST; (2) export control training for AIST staff; (3) export control instruction to individual staff members; (4) classification and transaction screening; and (5) internal audits, efforts are being made to raise awareness of security export control at staff level, and by maintenance of departmental systems, we are implementing appropriate export controls.
Promotion of Rational Procurement	We promote autonomous, continuous rational procurement with its operational attributes in mind while keeping its fairness, and transparency through the PDCA cycle, based on the Promotion of Rational Procurement in Incorporated Administrative Agencies (decided by the Minister for Internal Affairs and Communication May 25, 2015)	Each year, we formulate an AIST Rational Procurement Policy, and conduct ex-post facto inspections of individual contracts by a Contract Oversight Committee, whose members include outside experts. We answered to questions from members and obtained their agreement. Once a fiscal year ends, we conduct a self-assessment of how our rational procurement policy for the fiscal year has been implemented using the set indicators, and the results are publicized. As part of the CSR procurement and pursuant to the Act on Promotion of Government's Procurement of Goods Supplied by Facilities for Persons with Disabilities to Work, every year AIST also discloses its policy for promoting the procurement of goods from those facilities and its procurement results. As outcome of efforts in line with the policy, we were able to achieve a goal that exceeded the results of the previous year. Furthermore, AIST has introduced a procurement method that evaluates suppliers based on how they promote work-life balance, with the aim of realizing public procurement contributing to women's active participation in the workforce. (To see how the rational procurement plan is conducted, list of documents of the Contract Oversight Committee, AIST policy of Goods Supplied by Facilities for Persons with Disabilities to Work and procurement records, please look up announcements on the following website: aist.go.jp/aist_j/procure/)
Implementing Market Testing	In accordance with the Basic Policies on Public Service Reform, AIST Tsukuba conducts facility management under procurement contracts.	Continuing from FY 2021, operational administrative task and support of the information network system were conducted, and continuous, stable services were smoothly provided to the users. (To be continued up to FY 2022) In addition, from FY 2022, a new "Maintenance and Management Services for Facilities, etc. of Tsukuba West-7 Building, National Institute of Advanced Industrial Science and Technology" was implemented to ensure good management of building facilities, etc., and to carry out appropriate maintenance, inspection, and repair. (To be continued up to FY 2023).

Basic Information about AIST

Organization Profile

President	• Senior Vice-President • Vice-President • Vice-President (part-time)
Auditor	

Chief Executive Officer

• Compliance Promotion Committee • Security and Information Promotion Committee
• Human Resource Committee

Chief Research Officer

Research Strategy Planning Department

Department of Energy and Environment
Department of Life Science and Biotechnology
Department of Information Technology and Human Factors.
Department of Materials and Chemistry
Department of Electronics and Manufacturing
Geological Survey of Japan
National Metrology Institute of Japan

TIA Central Office

Global Research and Development Center for Business by Quantum-AI technology

Fukushima Renewable Energy Institute, AIST
AIST Kashiwa
AIST Tokyo Waterfront
Hokuriku Digital Manufacturing Center

AIST Hokkaido
AIST Tohoku
AIST Chubu
AIST Kansai
AIST Chugoku
AIST Shikoku
AIST Kyushu

Chief Management Officer

Management and Planning Headquarters
General Affairs Headquarters
Branding and Public Relations Department
Innovative Human Resources Department
Environment and Safety Headquarters
Security and Information Promotion Department

AIST Tsukuba

Chief Marketing and Business Officer

Planning Headquarters (AIST Tokyo Headquarters)

Audit Office

As of September 2023

Revenue and Expenditure

● Financial results for FY 2022 (unit: million yen)

Revenue 181,275

- Intellectual property revenue 822
- Technology consulting revenue 1,578
- Miscellaneous 4,501
- Joint research revenue 18,658
- Commisioned research funds 28,752 (from private companies 1,015)
- Facility maintenance grants 17,950
- Subsidy 109,016

Expenditure 129,849

- Department of Life Science and Biotechnology 7,544
- Indirect costs 9,927
- Department of Energy and Environment 20,562
- Facility management costs 14,930
- Department of Information Technology and Human Factors 13,769
- Research management costs 16,879
- Department of Materials and Chemistry 14,544
- National Metrology Institute of Japan 9,507
- Geological Survey of Japan 8,836
- Department of Electronics and Manufacturing 13,352

Notes1 : Total may not become 100% due to rounding off.
Notes2 : The amounts of revenue and expenditure are adapted from the "Financial Statement" prescribed in Article 38 of the Act on General Rules for Incorporated Administrative Agencies.

Staff

Total 11,429
Executives 10
Foreign nationals 654

- Administrative employees 742 6.5%
- Administrative contract employees 805 7.0%
- Administrative temporary employees 58 0.5%
- Researchers 2,436 21.3%
- Contract researchers 2,384 20.9%
- Temporary researchers 538 4.7%
- Contract SEs and maintenance staff 425 3.7%
- Emeritus Advisors and Emeritus Councilors 26 0.2%
- Industry–academia–government collaboration related people 4,015 35.1%

▶ Male and female ratio of administrative employees

Male 421 57%	Female 321 43%

0 20 40 60 80 100(%)

▶ Male and female ratio of researchers

Male 2,143 88%	Female 293 12%

0 20 40 60 80 100(%)

Administrative employees include executives.
Contract employees: SEs and maintenance staff
Industry–academia–government collaboration related people: related to joint research and technical training, and visiting researchers

As of March 2023

Reference Data

Data about promotion of research and development

Acceptance of external researchers for joint research

- From other domestic institutions
- From universities in Japan
- From private companies in Japan

(Persons)

FY	From other domestic institutions	From universities in Japan	From private companies in Japan
2018	322	410	1,575
2019	350	430	1,474
2020	327	405	1,258
2021	341	369	1,281
2022	290	398	1,547

Joint and commissioned research with companies

- Fund received for joint research
- Fund received for commissioned research
- Number of funded joint research projects
- Number of commissioned research projects

(100 million yen) / (Cases)

FY	Fund received for commissioned research	Fund received for joint research	Number of funded joint research projects	Number of commissioned research projects
2018	104	71.7	1,274	7.2
2019	101	76.7	1,245	8.6
2020	93	74.8	1,086	9.8
2021	89	86	1,063	8.9
2022	84	186.6	1,019	10.2

Number of technology consulting

(Cases)

FY	Cases
2018	515
2019	690
2020	687
2021	692
2022	784
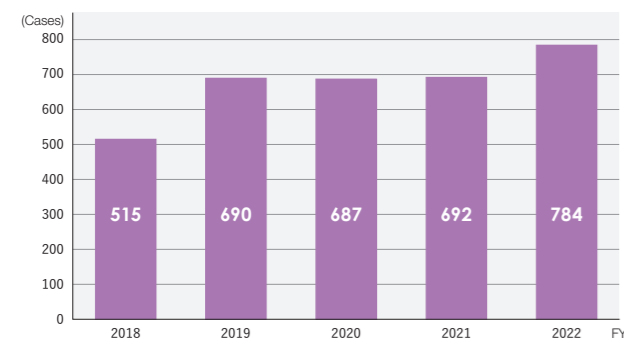
Number of proposed standards

- Domestic standards
- International standards

(Cases)

FY	Domestic standards	International standards
2018	13	37
2019	7	27
2020	9	25
2021	14	53
2022	26	29
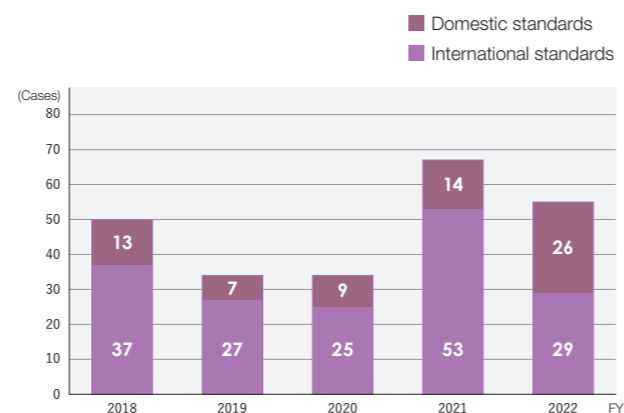
Contribution of AIST staff to international standardization activities

- Chairs, committee managers, convenors
- Experts

(Persons)

FY	Chairs, committee managers, convenors	Experts
2018	56	422
2019	57	436
2020	64	427
2021	69	429
2022	70	464
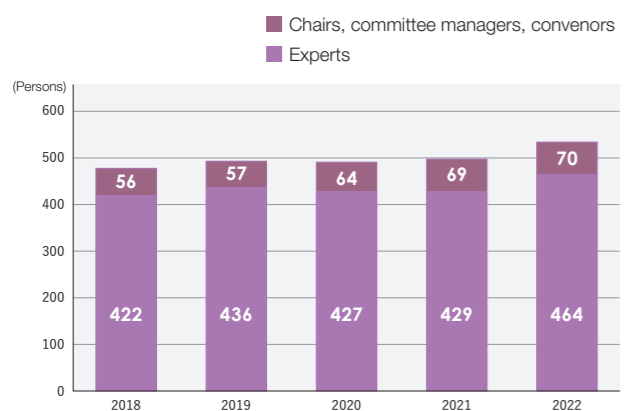
Number of cross-appointment program users

- Temporary transfers
- Acceptances

(Persons)

FY	Temporary transfers	Acceptances
2018	19	50
2019	16	51
2020	12	44
2021	11	37
2022	13	35
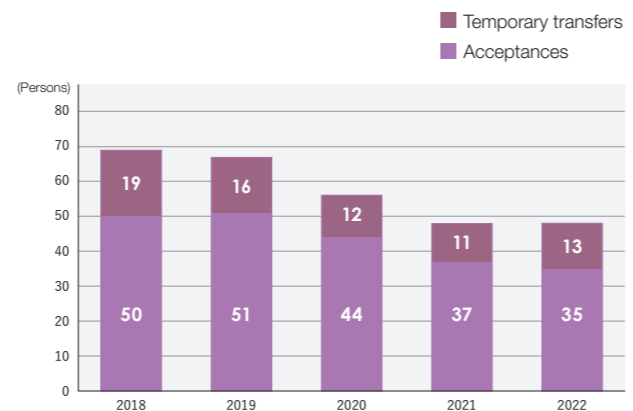
*The number is not the total as of April 1, 2023, but includes cases which terminated during FY 2022.

Number of trainees on technical training

- From overseas institutions
- From other domestic institutions
- From universities in Japan (from partner graduate schools)
- From private companies in Japan

(Cases)

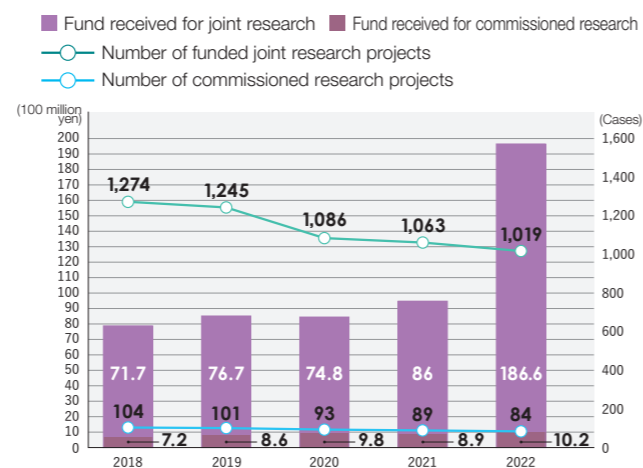| FY	From overseas institutions	From other domestic institutions	From universities in Japan (from partner graduate schools)	From private companies in Japan
2018	108	65	1,343	107
2019	118	48	1,306	135
2020	122	46	1,143	40
2021	143	32	1,122	20
2022	101	34	1,151	65

Number of foreign researchers

- Technical trainees
- Visiting researchers
- Contract employees
- Employees

(Persons)

FY	Technical trainees	Visiting researchers	Contract employees	Employees
2018	177	220	282	141
2019	231	196	288	149
2020	91	20	249	153
2021	67	5	210	147
2022	247	59	201	147

Number of foreign researchers by country and region in FY 2022

Total 654

- China 258(45)
- Korea 54(23)
- India 52(4)
- Asia, Oceania etc. 112(25)
- US 20(5)
- Americas etc. 18(6)
- France 42(10)
- Europe etc. 68(21)
- Australia, Middle East, Africa 30(8)
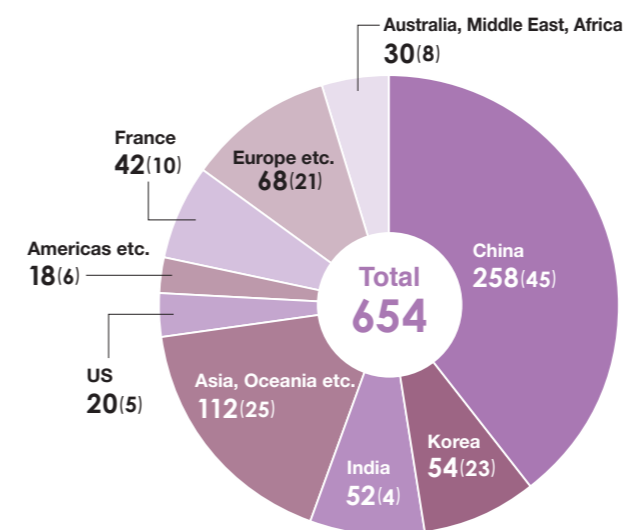
*Numbers in parentheses are those with employee status.

Data relating to human resources

Number of people who used the various leave programs

(Persons)

	FY2018		FY2019		FY2020		FY2021		FY2022	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Leave to care for sick children	139	217	122	219	89	147	98	153	125	265
Special childcare leave	42	22	39	21	30	13	30	15	33	40
Extended childcare leave*	11	37	15	48	12	35	21	30	36	22
Nursing care leave	72	57	75	59	48	40	48	46	78	111
Extended nursing care leave*	0	5	0	1	1	2	1	2	1	1

* Number of employees starting the leave within the fiscal year

Number of employees who used child daycare services

(Persons)

	FY2018		FY2019		FY2020		FY2021		FY2022	
	Permanent employees	Contract employees	Permanent employees	Contract employees	Permanent employees	Contract employees	Permanent employees	Contract employees	Permanent employees	Contract employees
AIST Tsukuba	1,681	897	834	1,047	473	73	534	241	482	170
AIST Chubu	15	87	93	59	18	11	15	27	24	18
AIST Kansai	136	21	134	45	4	1	38	0	54	4
Private child daycare facilities and babysitters	41	12	43	4	24	0	44	0	49	0

* total number

Change in employment rates for people with disabilities

% of June 1 of each year
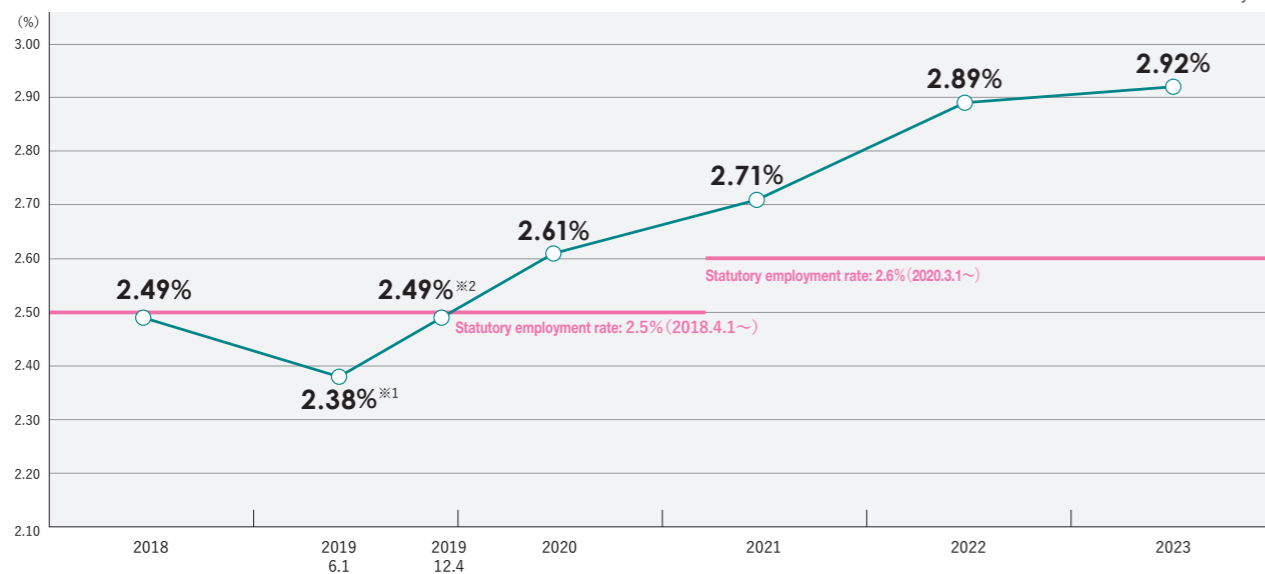
*1 Corrections were made after reinvestigation.
*2 As of December 4, 2019, the actual employment rate was 2.49%, but the number of legally employed persons (136 persons) calculated from the legally mandated employment rate of 2.50% has been met. Therefore, the statutory employment rate has been achieved.

Percentage of people with disabilities remaining at work

	FY2018	FY2019	FY2020	FY2021	FY2022
Number of people at the beginning of the fiscal year	105	111	110	115	120
Number of people who left AIST within the fiscal year	8	9	4	11	6
Employee turnover rate	7.62%	8.11%	3.64%	9.57%	5.00%
Employee retention rate	92.38%	91.89%	96.36%	90.43%	95.00%

* Retirees include those who retire or terminate their employment.

Employment rate by disability type
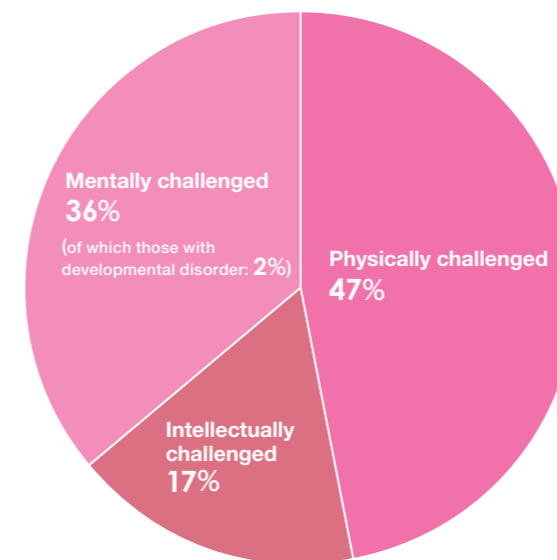
as of June 1, 2023

Health and safety data + Health management data

Trends in the number of occupational accidents

Legend: Other | External wounds | Falling over | Exposures to chemicals

(Cases)

Frequency rate of accidents resulting in absences from work

Legend: All industries | AIST

All industries values: 1.83 (2018), 1.80 (2019), 1.95 (2020), 2.09 (2021), 2.06 (2022)
AIST values: 0.20 (2018), 0.30 (2019), 0.10 (2020), 0.40 (2021), 0.10 (2022)

Calculation method
AIST: (number of applications for compensation for absence from work due to industrial accidents/total number of working hours) x 10^6
All industries: (number of deaths and injuries due to occupational accidents/total number of working hours) x 10^6
*The occupational injury rate for all industries is calculated by limiting the number of casualties to those who lost at least one day of work or lost part of their body or its function due to industrial accidents.
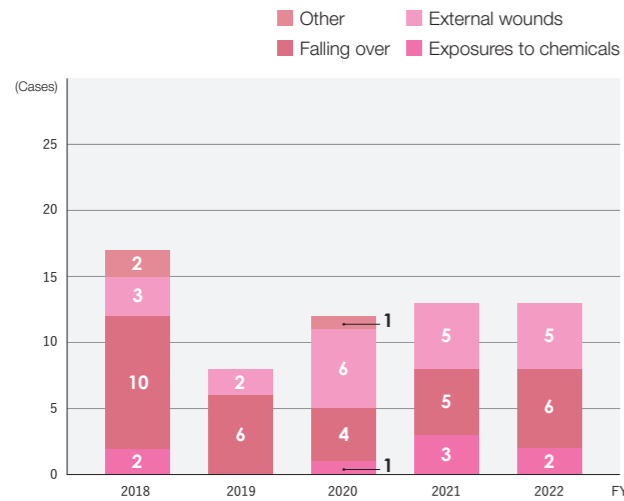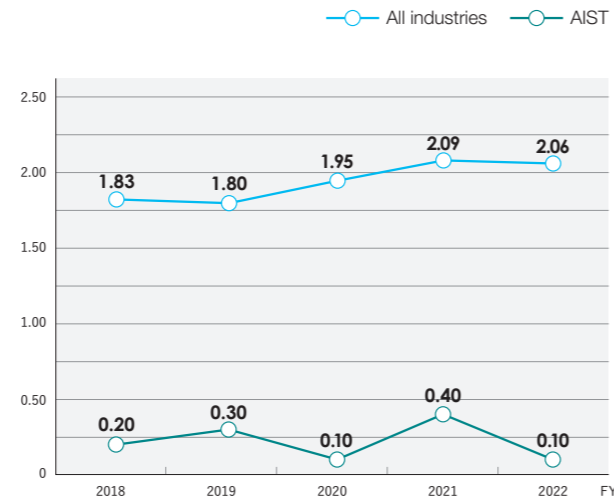
Main education and training programs and workshops held in FY 2022

Program	No. of sessions	No. of participants
Danger experience training (flammable gases)	1	21
Danger experience training (organic solvents)	1	23
Course on skills required for a Health Officer's License	2	56
Course on skills required for a Chief Technician's License for Using Organic Solvents	1	33
Course on skills required for a Chief Technician's License for Using Specified Chemical Substances	1	21
Courses on specialized safety (waste) (e-learning)	-	1,849
Education and training for recombinant DNA experiments (e-learning)	-	997
Education and training for animal experiments (e-learning)	-	326
Education and training on human ethics in life science experiments (e-learning)	-	242
Education and training for ergonomic experiments (e-learning)	-	458
Specific safety training course (radiation) (online workshop / e-learning)	31/-	91/399
Specific safety training course (X-ray) (for new X-ray researchers) (online workshop / e-learning)	30/-	126/427

Number and percentage of permanent and contract employees who underwent periodic medical examinations (including health screening), 2018–2022

Top: percentage of examinees   Bottom: no. of examinees/ total no. of eligible employees

	2018	2019	2020	2021	2022
(1) Employees (excluding (2)) *1	99.9%	99.8%	99.7%	99.7%	99.6%
	3,065/3,068	2,986/2,992	3,021/3,030	2,975/2,984	2,982/2,994
(2) Contract employees *2	99.9%	99.7%	99.9%	99.9%	99.5%
	2,455/2,456	2,569/2,577	2,399/2,401	2,409/2,411	2,426/2,437

*1 Excluding those on extended childcare leave and sick leave and those on long leave due to overseas relocation
*2 The target is short-term members of mutual aid association.

Number of permanent and contract employees (including temporary employees) who underwent special medical examinations in FY 2022

Special medical examination	Spring			Autumn		
	Permanent employees	Contract employees	Total	Permanent employees	Contract employees	Total
Medical examination for organic solvent poisoning prevention	715/715	678/678	1,393/1,393	700/700	692/692	1,392/1,392
Medical examination for specified-chemical poisoning	443/443	370/370	813/813	439/439	388/388	827/827
Medical examination for ionizing radiation exposure	343/343	76/76	419/419	337/337	79/79	416/416
Medical examination for lead poisoning	17/17	25/25	42/42	17/17	25/25	42/42
Medical examination for laser injury	338/338	125/125	463/463	38/38	28/28	66/66
Medical examination for pneumoconiosis	11/11	18/18	29/29	1/1	2/2	3/3
Medical examination for asbestos exposure	3/3	3/3	6/6	3/3	2/2	5/5

*no. of examinees/ total no. of applicable employees

Number of employees with significant findings from AIST's medical examinations, and number of employees who received face-to-face counseling

(1) Number of employees with significant findings, and their percentages of the total

FY	2018	2019	2020	2021	2022
With significant findings (D-diagnosis)	152	140	159	157	169
	3.5%	3.1%	3.7%	3.8%	4.0%
With significant findings (E-diagnosis)	822	817	872	857	849
	19.1%	18.3%	20.6%	20.7%	20.0%

(2) Number of employees who received counseling, and their percentages to employees with significant findings

FY	2018	2019	2020	2021	2022
With significant findings (D-diagnosis)	123	121	130	129	142
	80.9%	86.4%	81.8%	82.1%	84.0%
With significant findings (E-diagnosis)	718	726	779	789	766
	87.3%	88.9%	89.3%	92.1%	90.2%

Definition of criteria: A: no anomalies; B: mild abnormalities but no interference with daily life; C: follow-up examination required; D: health advice required; E: treatment required;   F: counseling required (applicable only to special medical examinations)

Number of face-to-face health consultations in FY 2018–2022

(Cases)

FY		2018	2019	2020	2021	2022
Industrial physician	Physical	1,573	1,439	921	736 *2	727
	Mental	551	573	525	777 *2	768
Industrial health staff		3,850	5,496 *1	5,599	5,414	4,338
Total		5,974	7,508	7,045	6,927	5,833

*1 From FY 2019, the number includes consultations for employees who received health screening at outside medical facilities and overworked employees (based on reform of working practices).
*2 Classification has been readjusted.

Flu shots (at AIST)

(Persons)

FY	2018	2019	2020	2021	2022
AIST Tsukuba/Tokyo	1,201	2,000	1,962	0	0
Regional research bases	566	578	640	0	0
Grand total	1,767	2,578	2,602	0	0

Other activities of health management

(Persons)

FY	2018	2019	2020	2021	2022		2018	2019	2020	2021	2022
Exercises to refresh	192	198	video streaming	video streaming	video streaming	Workshops (training)	227	183	239	214	246
Walking lessons	175	82	*	video streaming	video streaming	Anger management workshops	-	119	43	50	-
Emergency first-aid workshops	138	145	*	video streaming	video streaming	dental health	-	-	-	video streaming	video streaming
Mental health seminars	115	55	146	video streaming	video streaming	Food and nutrition seminar	-	-	-	-	video streaming

* Due to Covid-19, the event was not held. (Exercises to refresh were conducted via video streaming.)

Environmental Reporting Data

Energy

●Changes in amounts of energy used

Legend: city gas, purchased energy, etc. / Electricity

(TJ)	2018	2019	2020	2021	2022 FY
city gas, purchased energy, etc.	166	162	153	161	140
Electricity	2,049	2,009	1,937	1,896	1,933
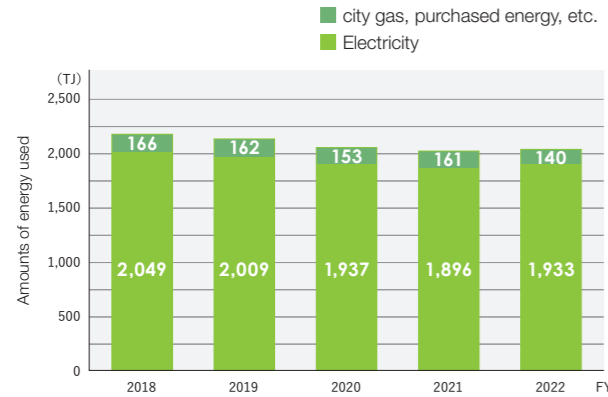
●Progress in renewable energy generation and CO₂ emissions reduction

Legend: Wind power-generated electricity (MWh) / Solar power-generated electricity (MWh) / CO₂ emissions reduction effect (t)

(MkWh)	2018	2019	2020	2021	2022 FY
Wind	229	147	174	184	146
CO₂ reduction	974	965	1,001	1,080	1,024
Solar	1,843	1,907	1,955	2,113	2,033

Water resources

●Breakdown of water received

Unit: 1000㎥

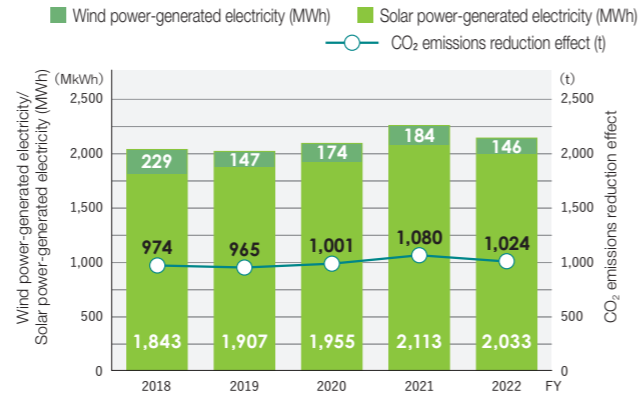|	2018	2019	2020	2021	2022
Potable water	937	974	913	795	740
Groundwater	14	14	8	7	8
Industrial water	0	0	0	0	0
Received water	951	988	921	802	747
Reused water	920	913	897	831	872

●Changes in amounts of water received and reused

Legend: Received water / Reused water

(1000㎥)	2018	2019	2020	2021	2022 FY
Reused water	920	913	897	831	872
Received water	951	988	921	802	747
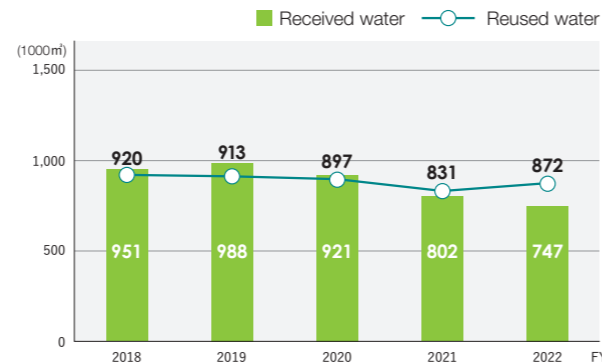
Atmospheric emissions

●Changes in CO₂ emissions by year

(1000t-CO₂)	2018	2019	2020	2021	2022 FY
Total greenhouse gas emissions	110	105	99	100	102
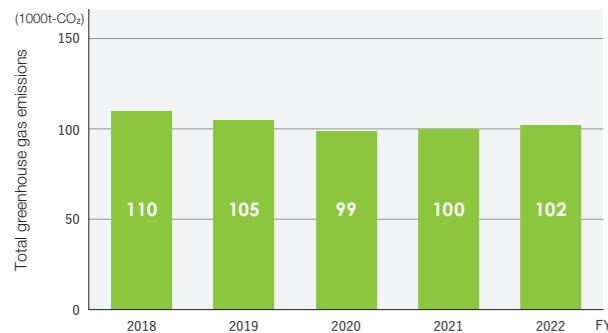
●Estimated leakage of CFCs (FY 2022)

Type	R-number	Estimated t-CO₂e released by R-number	Estimated t -CO₂ released by type
HCFC	R22	0	0
HFC	R32	4.6	226.9
	R134a	0	
	R404A	15.7	
	R407C	55.8	
	R410A	150.8	
Mixed	Mixed refrigerant	0	0
Total			226.9

●Changes in atmospheric environmental loads

Legend: SOx / NOx

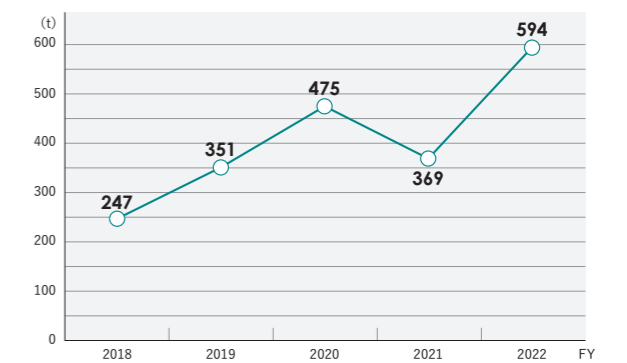| (t)	2018	2019	2020	2021	2022 FY
SOx	0.02	0.01	0.01	0.01	0.01
NOx	2.02	2.29	1.80	1.60	1.87
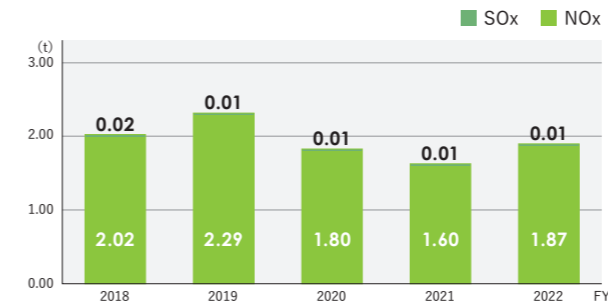
Waste

●Breakdown of generated waste (FY 2022)

Waste type	Amount disposed of (t)	Amount landfilled (t)	Percentage of waste landfilled (%)
Non-industrial waste	497.20	102.89	20.7
Industrial waste	1,552.18	462.30	29.8
Plastic waste	355.39	36.82	10.4
Metal scrap	268.91	24.45	9.1
Sludge	458.32	361.81	78.9
Glass/concrete/ceramic waste	132.79	12.88	9.7
Slag	30.2	0	0.0
Other	306.57	26.34	8.6
Specially controlled industrial waste	369.37	28.36	7.7
Flammable waste oil	15.61	0.66	4.2
Strong acids	265.48	7.88	3.0
Infectious waste	16.26	1.73	10.6
Waste oil (hazardous)	4.137	0.02	0.4
Sludge (hazardous)	15.42	0.01	0.0
Acid waste (hazardous)	0.77	0.36	46.2
Other	51.69	17.71	34.3
Total	2,419	594	24.5

●Changes in amounts of disposed waste

Legend: Specially controlled industrial waste / Industrial waste / Non-industrial waste

(t)	2018	2019	2020	2021	2022 FY
Non-industrial waste	478	418	361	389	369
Industrial waste	1,689	2,429	1,639	1,295	1,552
Specially controlled industrial waste	602	612	733	377	497

●Changes in amounts of landfill waste

(t)	2018	2019	2020	2021	2022 FY
Landfill waste	247	351	475	369	594

●Storage and disposal of PCB-containing items and PCB waste

Waste type	Quantity stored at the end of FY 2020	Quantity added in FY 2021	Quantity disposed of in FY 2021	Quantity stored at the end of FY 2021	Quantity added in FY 2022	Quantity disposed of in FY 2022	Quantity stored at the end of FY 2022
Capacitors	1,588	9	1,441	156	0	156	0
Electrical ballasts	685	0	678	7	1	8	0
Transformers	2	0	0	2	5	1	6
Oils/paints (L)	0 ℓ	0 ℓ	0 ℓ	0 ℓ	0 ℓ	0 ℓ	0 ℓ
Other contaminated materials	Stored research chemicals, etc.	Added waste cloth used for analysis	Disposed waste cloth used for analysis	Stored research chemicals, etc.	Added waste cloth used for analysis	Disposed research chemicals and waste cloth used for analysis	Stored research chemicals, etc.

Water quality

● Monitoring of groundwater at AIST Kansai

Sampling month	Measurement of arsenic and arsenic compounds (standard: ≤ 0.01 mg/L)	Sampling month	Measurement of arsenic and arsenic compounds (standard: ≤ 0.01 mg/L)
April 2022	0.012	October 2022	0.016
May 2022	0.022	November 2022	0.039
June 2022	0.013	December 2022	0.032
July 2022	0.023	January 2023	0.030
August 2022	0.014	February 2023	0.024
September 2022	0.013	March 2023	0.038

Appropriate Management of Chemical Substances (FY 2022)

● Amount of chemicals reported under the Chemical Control Program

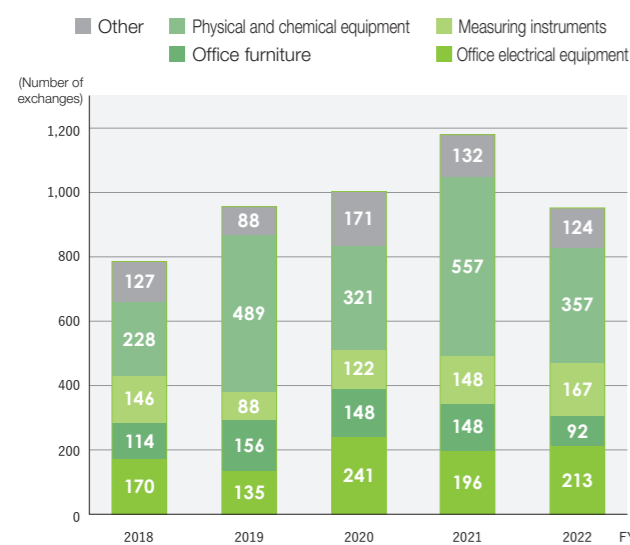| Research site	Substance	Amount used	Amount released	Amount transferred	
			Air	Sewer	Waste
Fukushima Renewable Energy Institute, AIST	Ammonia (kg)	2,900	0	0	94
AIST Tsukuba Central 5	Chloroform (kg)	1,900	390	0	1,500
	Dichloromethane (kg)	1,200	210	0	1,000
	n-hexane (kg)	1,000	430	0	610
AIST Tsukuba West	Ferric chloride (kg)	78,000	0	0	0
	N,N-dimethyl acetamide (kg)	1,700	0	0	1
	Hydrogen fluoride and aqueous salts thereof (kg)	3,200	0	360	370
AIST Kansai	VOC (kg)	1,400	77	0	1,300

*AIST Tsukuba Central 5 and AIST Tsukuba West: PRTR system (Substances with an annual handling quantity of 1 t or more among the substances subject to the PRTR system are listed)
AIST Kansai: Osaka Prefectural Ordinance (Substances with an annual handling quantity of 1 t or more among the applicable substances are listed)
Fukushima Renewable Energy Institute, AIST (FREA): Fukushima Prefecture Guidelines (Substances whose handled, released, or transferred quantity is 100 kg or more are listed)

Reuse of equipment etc.

● Reuse within AIST

■ Other　■ Physical and chemical equipment　■ Measuring instruments
■ Office furniture　■ Office electrical equipment

(Number of exchanges)

Environmental accident drills

● Environmental accident drills in FY 2018–2022

FY	2018	2019	2020	2021	2022
Number of drills	18	19	19	19	19

Green purchasing and environmentally conscious contracts

● Purchase Results of Eco-friendly Goods and Services

Area	Item		Item	Total quantity purchased	Purchase of specified purchase items	Target attainment
Paper	Photocopier paper		100%	22,597.9kg	22,597.9kg	100%
	Forms		100%	4.2kg	4.2kg	100%
	Coated paper for inkjet color printers		100%	186.5kg	186.5kg	100%
	Toilet rolls		100%	5,463.9kg	5,463.9kg	100%
	Tissue paper		100%	10,334.6kg	10,252.6kg	99%
Stationery	Mechanical pencils		100%	400	393	98%
	Mechanical pencil leads		100%	360	359	100%
	Ballpoint pens		100%	8,608	8,551	99%
	Marker pens		100%	8,087	7,942	98%
	Media cases		100%	453	453	100%
	Glue (including glue sticks and glue pouches)		100%	1,465	1,465	100%
	Adhesive tape		100%	739	739	100%
	Files		100%	54,924	54,738	100%
Office furniture, etc.	Chairs		100%	925	907	98%
	Desks		100%	510	507	99%
Copying devices	Photocopiers, etc. *	Purchased	100%	23	23	100%
		Leased/rented (new)		35	35	
		Leased/rented (extension)	-	-	-	-
	Scanners	Purchased	100%	66	66	100%
		Leased/rented (new)	-	-	-	-
		Leased/rented (extension)	-	-	-	-
	Toner cartridges		100%	2,704	2,675	99%
	Ink cartridges		100%	1,463	1,439	98%
Office equipment	Paper shredders	Purchased	100%	51	51	100%
		Leased/rented (new)	-	-	-	-
		Leased/rented (extension)	-	-	-	-
Vehicles, etc.	Non-general official vehicles	Purchased	100%	2	1	91%
		Leased/rented (new)		9	9	
		Leased/rented (extension)	-	-	-	-
Fire extinguishers	Fire extinguishers		100%	12	12	100%
Services	Passenger transportation		100%	1,172	1,172	100%

*: Photocopiers, combination units, digital photocopiers with expandable functions

● Type and number of environmentally conscious contracts (FY 2022)

Type of green contract	Number of cases
Automobile purchase	9
Contract for power supply	14
Industrial waste	30

A report is more likely to be understood and empathized with by readers if it presents an overall picture of the organization's activities and direction in an easy-to-understand manner, and if it accurately describes the issues that society is seeking to address. The following two points are representative examples of how this report is viewed from this perspective. The first is the "Efforts to Establish a National Innovation Ecosystem" diagram, which I assume is based on the so-called "Octopus Model" of the IIRC Framework, is a very good illustration of the positioning of AIST's various activities. In the future, it would be helpful to add social issues and identified materiality to the diagram for better understanding. IIRC has partially modified this model diagram to depict paths in which outcomes are derived not only from outputs but also from business activities. This path may also be very significant when looking at the various activities of the institute.

The issue that society is demanding is social implementation. Recent R&D investment efficiency shows that Japan ranks low among major industrialized countries, and this is thought to be due to the fact that new technologies are not implemented in society. For this reason, there are high expectations for your institute, which has been responsible for R&D most directly related to industrial competitiveness among the designated national research and development institutes and has promoted collaboration with industry as represented by the Cooperative Research Laboratories. In this report, the awareness of issues related to social implementation has been raised for several years, and various measures to expand social implementation were included in the Fifth Medium- and Long-term Plan in 2020, and concrete

activities began to be developed with the establishment of the Marketing and Business Development Headquarters in 2022. This report describes the background of the establishment of AIST Solutions Co., which is a further development of the Marketing and Business Development Headquarters, and its future prospects. We hope that the company's promotion of open innovation and the realization of social implementation will not only increase the efficiency of R&D investment, but also help solve social issues and give birth to many sustainable businesses.

On the other hand, there are some points that are difficult to understand and empathize with. One is the description of the information leak incident, which leaves the impression that the reporting is insufficient. The top message mentions it somewhat, but there is no mention of it in the main text. This case is so important that the government has taken the opportunity of this incident to launch a review of risk responses to technology leaks at research institutions, and has called for the strengthening of management systems. It is said that the report should have an organic structure between the top message and the main text, but unfortunately, the report does not include the full details of the incident, the management system, and measures to prevent recurrence. We hope that the next edition of the report will include these three items as well as a verification report on the effectiveness of the recurrence prevention measures.

Workers Club for Eco-harmonic Renewable Society (NPO)
YAMAGUCHI Tamio, Director

AIST has entered the second half of its 5th Medium- to Long-term Plan Period. We have launched our management reforms to be the core of the national innovation ecosystem by making significant contributions to solving social problems and strengthening industrial competitiveness of Japan, and in the words of the President, we are now in the stage of "a thorough implementation of the decisions we have made."

I would like to review a few points that I think were important for AIST over the past year. First, AIST Solutions (AISol) was established as a wholly owned subsidiary of AIST. This is a full-fledged development of AIST's marketing function to companies, which is groundbreaking for a national research and development agency, and is expected to accelerate solving social issues, which is the key to management reform. In addition, with national projects such as development of top-edged semiconductors, quantum computers, and AI in the limelight, I am pleased that AIST has become a core research institute, and that this is an excellent opportunity for its capabilities to be widely recognized in Japan and abroad, and we must now show remarkable performances in line with those capabilities. Another point is that AIST has strengthened its branding and public relations strategy in order to gain highly-accepted recognition for creating and sharing its value. We have developed the ability to appeal AIST's competitiveness to a wide range of stakeholders through innovative and cost-effective technologies and developments.

In the reform of AIST, I would like to mention a few issues that need to be resolved. The first is to secure our required human capitals. In order to expand business areas and to succeed in the

management reform, I believe it is necessary to significantly increase the scale of our human capitals while maintaining and improving their excellence. This will also help to alleviate the stress of the employees, which has increased inevitably with the management reform, and to maximize their potential. To achieve this, it is necessary to develop and implement our innovative recruitment and training strategy away from our current conventional personnel and recruiting management system similar to systems for civil servants. I hope that we will overcome many formidable obstacles and succeed in developing our new systems for qualified recruitment and human capital management. Second, the arrest of an employee this year for violation of the Unfair Competition Prevention Act is very regrettable, and we should not forget that the trustworthy relationship with companies and other stakeholders was damaged by the intentional leakage of research information. I request that each employee make principle-base judgment how to prevent information leaks perfectly. Finally, AIST's research organization has been horizontally aligned with five research domains and two research centers since its inception, but not only the differences in the size of each domain and center have expanded, but also the objectives of research have diversified. It is so important to deepen the discussion how AIST will attain the best organizational governance of our whole research systems, taking advantage of AISol,.

I will make further efforts to perform my duties as an auditor, including most effective monitoring, in order to contribute to the management reforms that will create what AIST should be tomorrow.

Auditor **NAKAZAWA Hiroshi**

AIST has published the AIST Report Sustainability Report, which is structured based on ISO 26000, on activities related to the environment and occupational health and safety at AIST Tsukuba and research bases nationwide, as well as activities related to organizational social responsibility.

In his top message, Chief Executive Officer ISHIMURA Kazuhiko, President of AIST, expressed his determination to drive social implementation research with AIST's technologies by establishing AIST Solutions Co. and creating a mechanism to quickly link AIST's technology seeds to social implementations. This initiative is described in the opening feature articles, "Efforts to Establish a National Innovation Ecosystem" and "Establishment and Objectives of AIST Solutions Co." The report also introduced the results of the "Integrated Fields Project," which aims to solve social issues. SATO Yasuhiro, external board member and special advisor to Mizuho Financial Group, Inc., expressed high
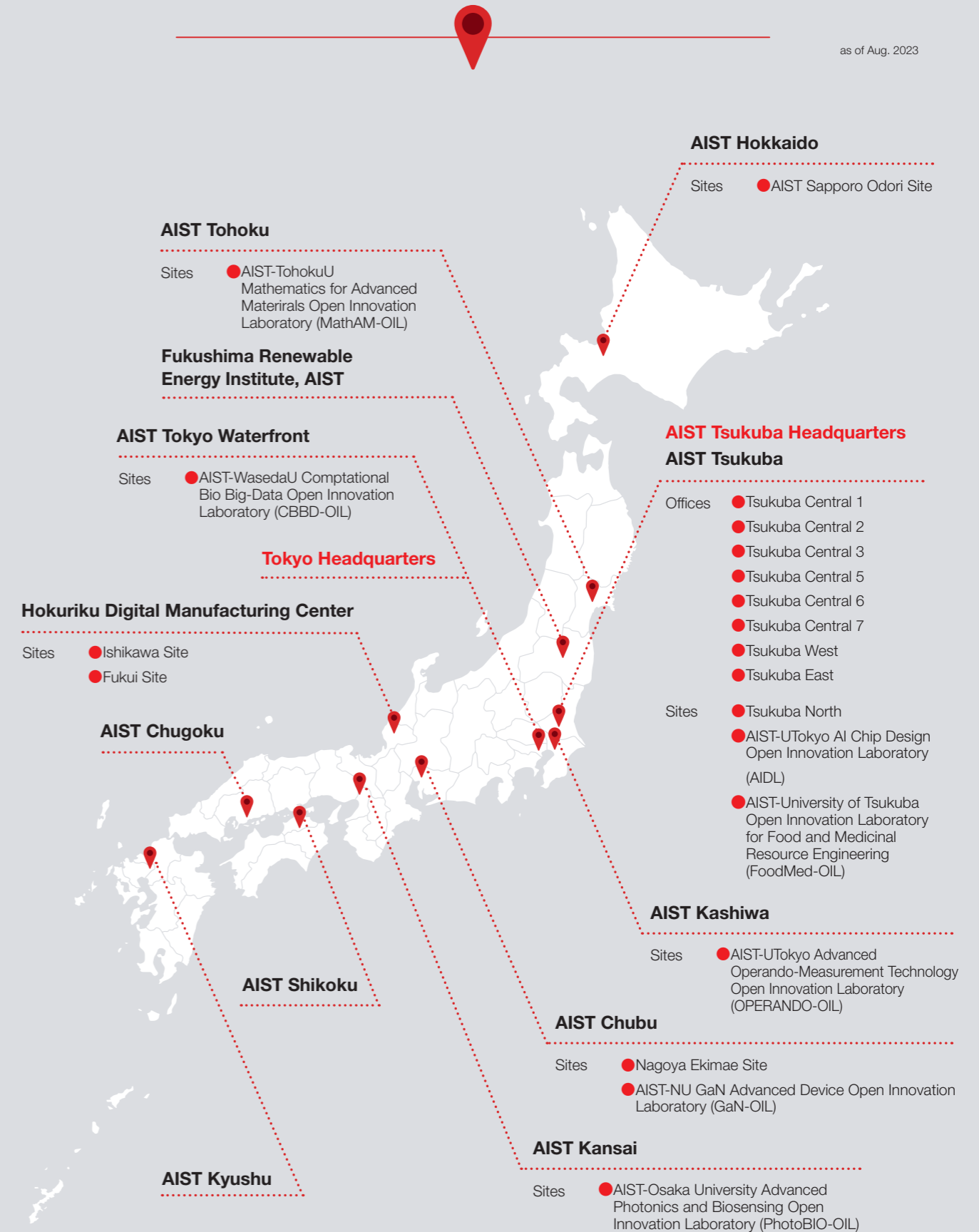
expectations for AIST's efforts to challenge open innovation and gave an encouraging message of support and cooperation from the industrial world. At the end of the report, as a third-party opinion, we received valuable comments and guidance from Mr. YAMAGUCHI Tamio, Director of the Workers Club for Eco-harmonic Renewable Society, a non-profit organization. An opinion based on an internal perspective of the organization by NAKAZAWA Hiroshi, Auditor, is included in the report.

With AIST Vision: "Create the Future, Collaborate Together" in mind, AIST and AIST Solutions will strive to build an even deeper relationship of trust with society by introducing to our many stakeholders through this report the activities of AIST and AIST Solutions, as the AIST Group, to solve social issues together.

MIYAZAKI Koyomi,
Director, Branding and Public Relations Department

Research Bases

as of Aug. 2023

AIST Hokkaido
Sites ● AIST Sapporo Odori Site

AIST Tohoku
Sites ● AIST-TohokuU Mathematics for Advanced Materials Open Innovation Laboratory (MathAM-OIL)

Fukushima Renewable Energy Institute, AIST

AIST Tokyo Waterfront
Sites ● AIST-WasedaU Comptational Bio Big-Data Open Innovation Laboratory (CBBD-OIL)

Tokyo Headquarters

Hokuriku Digital Manufacturing Center
Sites ● Ishikawa Site
● Fukui Site

AIST Chugoku

AIST Shikoku

AIST Kyushu

AIST Tsukuba Headquarters
AIST Tsukuba
Offices ● Tsukuba Central 1
● Tsukuba Central 2
● Tsukuba Central 3
● Tsukuba Central 5
● Tsukuba Central 6
● Tsukuba Central 7
● Tsukuba West
● Tsukuba East
Sites ● Tsukuba North
● AIST-UTokyo AI Chip Design Open Innovation Laboratory (AIDL)
● AIST-University of Tsukuba Open Innovation Laboratory for Food and Medicinal Resource Engineering (FoodMed-OIL)

AIST Kashiwa
Sites ● AIST-UTokyo Advanced Operando-Measurement Technology Open Innovation Laboratory (OPERANDO-OIL)

AIST Chubu
Sites ● Nagoya Ekimae Site
● AIST-NU GaN Advanced Device Open Innovation Laboratory (GaN-OIL)

AIST Kansai
Sites ● AIST-Osaka University Advanced Photonics and Biosensing Open Innovation Laboratory (PhotoBIO-OIL)